JUDAY CREEK
FEASIBILITY STUDY

ST. JOSEPH COUNTY, INDIANA

March 2002

Prepared For:
St. Joseph County Drainage Board
Room 1100 County-City Building
South Bend, Indiana 46601

Prepared By:
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EXECUTIVE SUMMARY

The primary objective of this study was to locate, conceptually design, and foster the development of additional projects that would improve the water quality and fish habitat in Juday Creek. This study explores the feasibility of the general recommendations made in the 1995 Juday Creek Watershed Management Plan. In general, the study focuses on projects that will reduce stream bank erosion and surface erosion on land adjacent to the creek, as well as projects that will reduce pollutant loading from roads and parking lots. A secondary objective of the study was to document the existing restoration projects and evaluate their success.

To accomplish the study objectives, J.F. New & Associates (New) held three public meetings, conducted field investigations of the entire stream, reviewed all previous studies, conceptually designed nine new projects, and solicited the opinions of all landowners and regulatory agencies with jurisdiction over the selected sites. J.F. New evaluated the nine sites for environmental impacts, social concerns, and physical implementation factors. J.F. New also developed cost estimates and timelines, and identified funding sources for each proposed project.

The nine projects identified include: 1) bank stabilization and habitat development west of Brooktrails Drive, 2) bank stabilization and outlet repairs at Kenilworth Road, 3) a wetland filter construction at US 933 and the Toll Road, 4) stream reconstruction and a stormwater filter construction between Douglas and Ironwood Roads, 5) the filling of an existing ornamental pond off Douglass Road, 6) habitat installation and bank stabilization between Edison Lakes Parkway and Fir Road, 7) buffer strip installation from Fir Road to the Toll Road and two Toll road projects involving 8) bank stabilization and 9) an infiltration trench. All of the projects received letters of support from both the property owners and the regulatory agencies with jurisdiction. Project anticipated start dates are between 2002 and 2004.

ACKNOWLEDGEMENTS

This Feasibility Study was performed with funding from the Indiana Department of Natural Resources – Lake and River Enhancement Program (LARE) and sponsored by the St. Joseph County Drainage Board.

Several individuals and agencies provided significant contributions to this study, including Michael Massonne of the Indiana Department of Natural Resources' Division of Soil Conservation, John McNamara, John Law, and Steve Decloedt of the St. Joseph County Drainage Board, Joe Mitchell of River Tenders Inc., Jim Lovell of Confluence Consulting Inc., and Ed Mackowicz of EFM Construction Inc.

John Richardson, the Project Manager for this study authored this report. Contributors included Drew Bender (Environmental Engineer), Marianne Giolitto (Biologist), Brian Majka (Environmental Biologist), Sara Peel (Aquatic Ecologist), Cornelia Sawatsky (Aquatic Ecologist), and Steve Zimmerman (Aquatic Ecologist).

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1.0 INTRODUCTION

1.1 BACKGROUND

In 1995, Cole Associates, Inc. completed the "Juday Creek Watershed Management Plan." To explore the feasibility of the watershed management plan's general recommendations, the St. Joseph County Drainage Board applied for and received a grant from the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement program (LARE). The Drainage Board hired J.F. New & Associates (New) to study the feasibility of selected Best Management Practices (BMPs) for specific stream reaches (Reaches 1 through 7 on Figure 1) of Juday Creek in St. Joseph County, Indiana.

1.2 SCOPE OF STUDY

The scope of the study encompasses the entire Juday Creek channel from the St. Joseph River to Granger, Indiana and its adjacent Drainage Board right-of-way. Historically, Juday Creek likely possessed good to excellent water quality. Agricultural, commercial, and residential development of the watershed has impaired the stream's original habitat. Development of a watershed typically increases silt loads, peak flows, and temperatures in a stream, all of which may impact the stream's biological community. In March 2001, J.F. New (New) conducted a field survey to assess both existing and potential site improvements on Juday Creek. New examined each stream reach in detail. Through public meetings (Appendix A) and from the field survey (Appendix B), New developed a list of all potential BMP's. After review, the list was condensed to nine proposed projects (Figure 1). The following are projects included in this study:

1. Stabilization/habitat improvement west of Brooktrails Drive
2. Erosion control surrounding stormwater outlet at Kenilworth Road
3. Stream reroute/wetland filter (southeast side of Interstate 80/90 at US 933)
4. Stream reconstruction/wetland filter between Ironwood and Douglas Roads
5. Pond fill/constructed stream channel (Douglas Road east of Ironwood)
6. Habitat improvement from Edison Lakes Parkway to Fir Road
7. 30-foot filter strips from Capitol Avenue to Interstate 80/90
8. Infiltration trench on the south side of Interstate 80/90
9. Regraded slope/bank stabilization of ditch north of Interstate 80/90

1.3 OBJECTIVE

The objective of this feasibility study was to locate, conceptually design, and foster the development of potential projects that will improve water quality and fish habitat in Juday Creek.

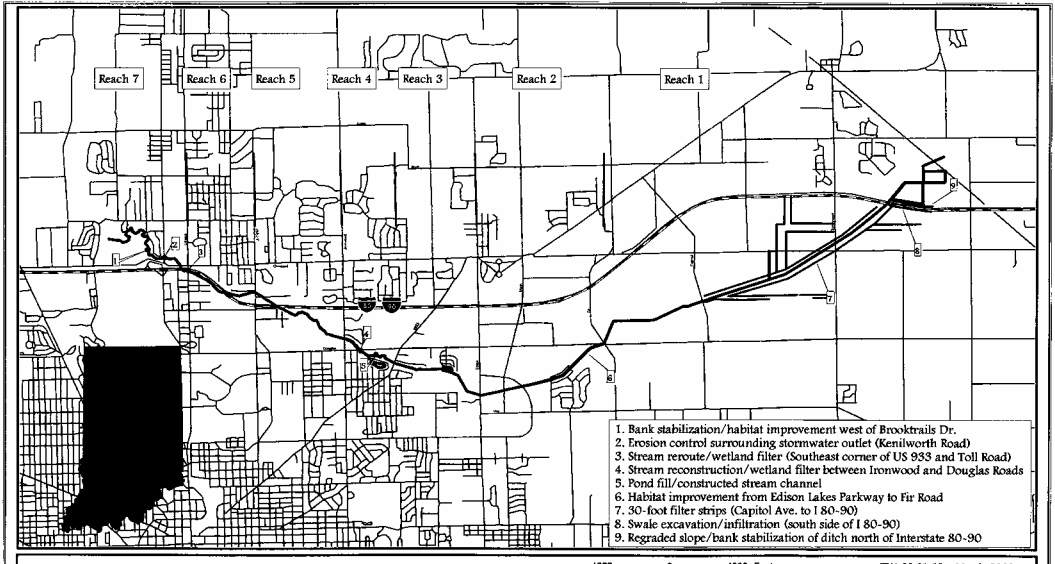
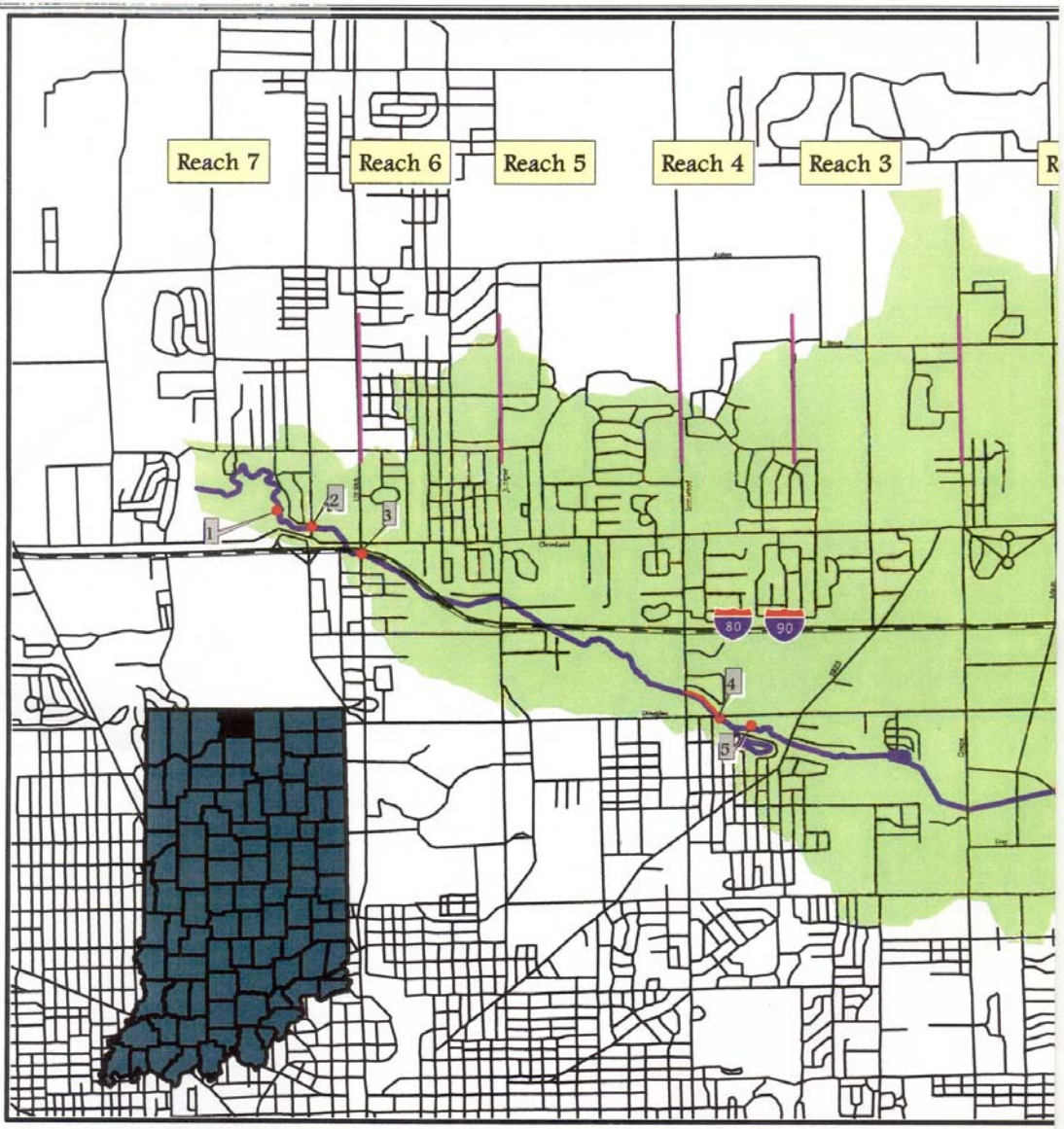


Figure 1: Lower Watershed and Proposed Projects
Juday Creek Feasibility Study
St. Joseph County, Indiana

JFNA 00-01-12 March, 2002



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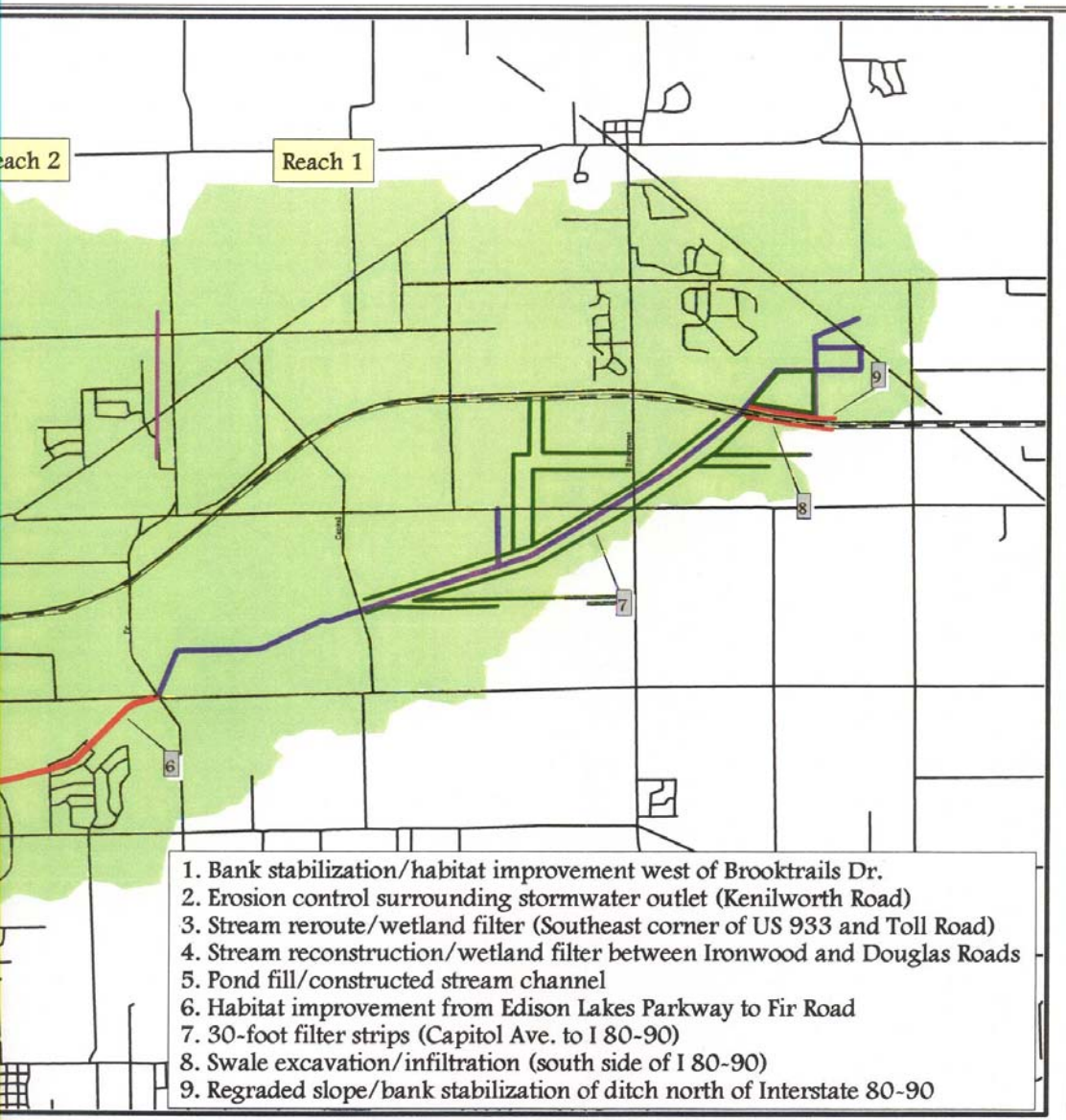

1. Bank stabilization/habitat improvement west of Brooktrails Dr.
2. Erosion control surrounding stormwater outlet (Kenilworth Road)
3. Stream reroute/wetland filter (Southeast corner of US 933 and Toll Road)
4. Stream reconstruction/wetland filter between Ironwood and Douglas Roads
5. Pond fill/constructed stream channel
6. Habitat improvement from Edison Lakes Parkway to Fir Road
7. 30-foot filter strips (Capitol Ave. to I 80-90)
8. Swale excavation/infiltration (south side of I 80-90)
9. Regraded slope/bank stabilization of ditch north of Interstate 80-90

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Scale: 1"=4000'

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JFNA 00-01-12 March, 2002

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Permitting - Delineations - Mitigation Design - Biological Inventories
Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

2.0 DESCRIPTION OF STUDY AREA

2.1 LOCATION

The Juday Creek Watershed (8 Digit-HUC 04050001), encompassing 37.7 square miles (24,128 acres), is located in St. Joseph County, Indiana and Cass County, Michigan (Figure 1). The 12-mile long stream originates in a small wetland in Granger, Indiana and immediately flows through agricultural fields in Reach 1. From Reach 1, the stream flows through residential and commercial development in Reaches 2 through 6. In Reach 7, near the stream's confluence with the St. Joseph River, Juday Creek winds through approximately 300 feet of natural woodland maintained by the St. Joseph County Chapter of the Izaak Walton League of America (Lamberti and Berg, 1995).

2.2 GEOLOGIC HISTORY

The Juday Creek drainage basin formed during the most recent glacial retreat of the Pleistocene Era. The glacial advance and retreat of the Huron-Saginaw Lobe of the last Wisconsian glaciation shaped much of the present topography within the watershed and the northern two-thirds of Indiana (Wayne, 1966). The broad, flat to rolling glaciated plain left by the retreat of the Huron-Saginaw Lobe includes glacial fill and outwash, sandy gravelly beach ridges, and flat belts of morainal hills and bog kettle depressions (Simon, 1997). Many of these features are visible on the Juday Creek Watershed landscape today. This geologic history defines the watershed's ecoregion and shapes the current land use in the watershed.

LAND USE

The Juday Creek Watershed has suffered from impacts of both agriculture and urbanization. Prior to settlement, the area was a mix of natural oak-hickory forest and wetlands. Settlement resulted in forests being cleared, wetlands being drained, and streams being straightened in an attempt to farm the rich soils. Today, row crop agriculture accounts for approximately 40% of the land use (Table 1, Figure 2). Pasture/hay, low intensity residential, and deciduous forest are also important components of land use within the watershed. The land uses cover 20%, 18%, and 14% of the watershed, respectively (Table 1, Figure 2). Refer to Figure 2 for a complete Juday Creek Watershed land use map.

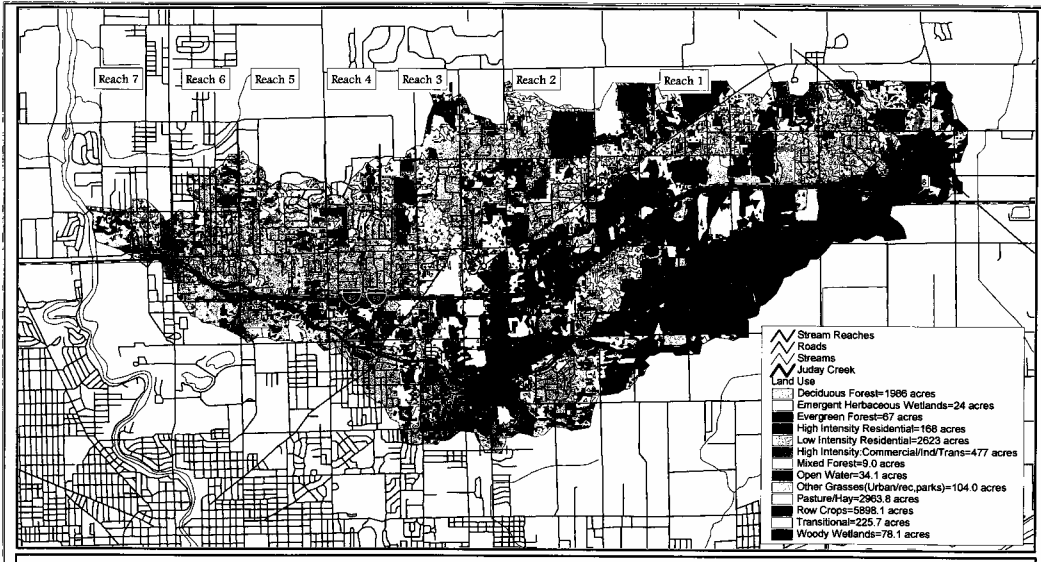

Figure 2: Land Use
Juday Creek Feasibility Study
St. Joseph County, Indiana

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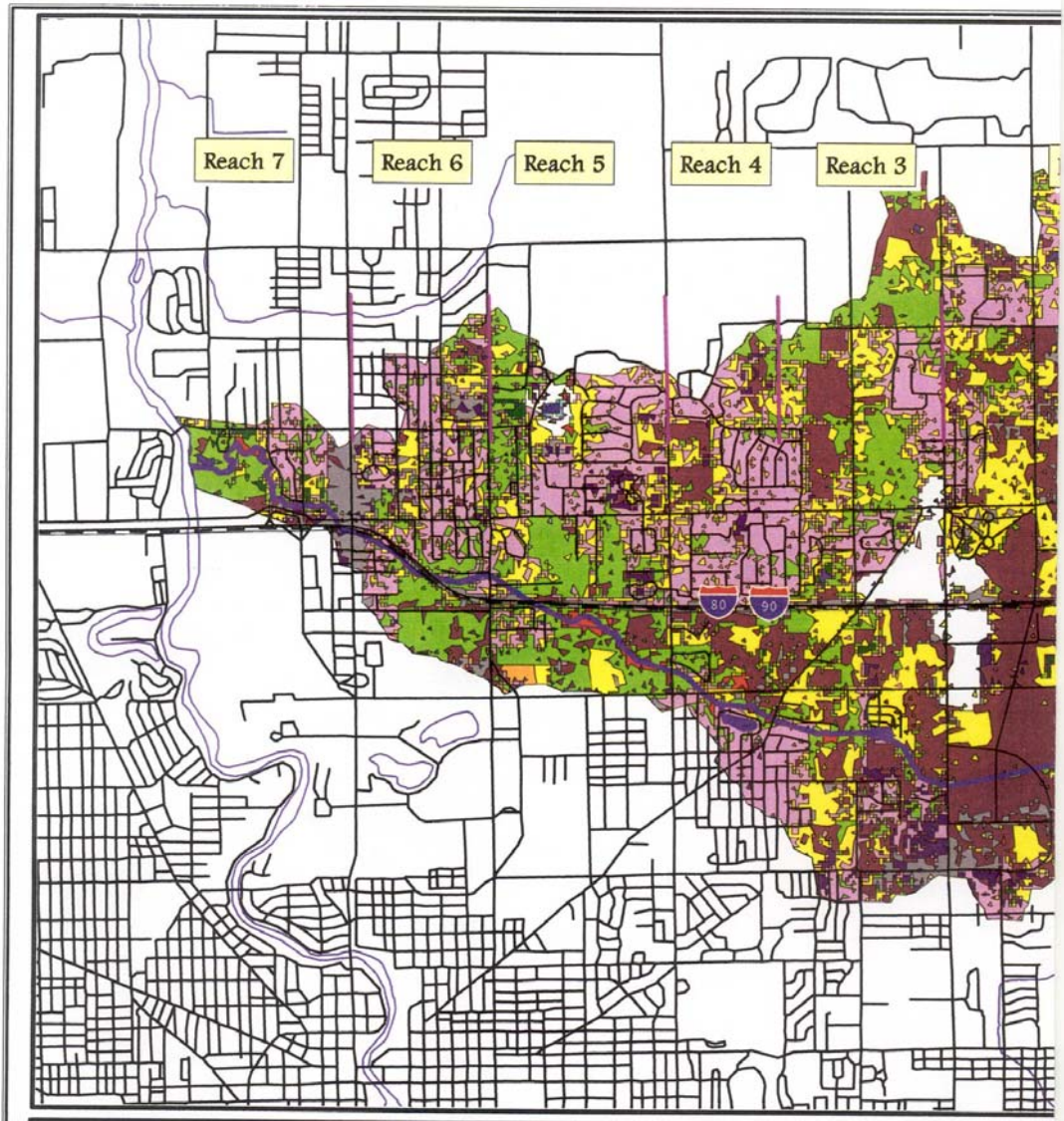
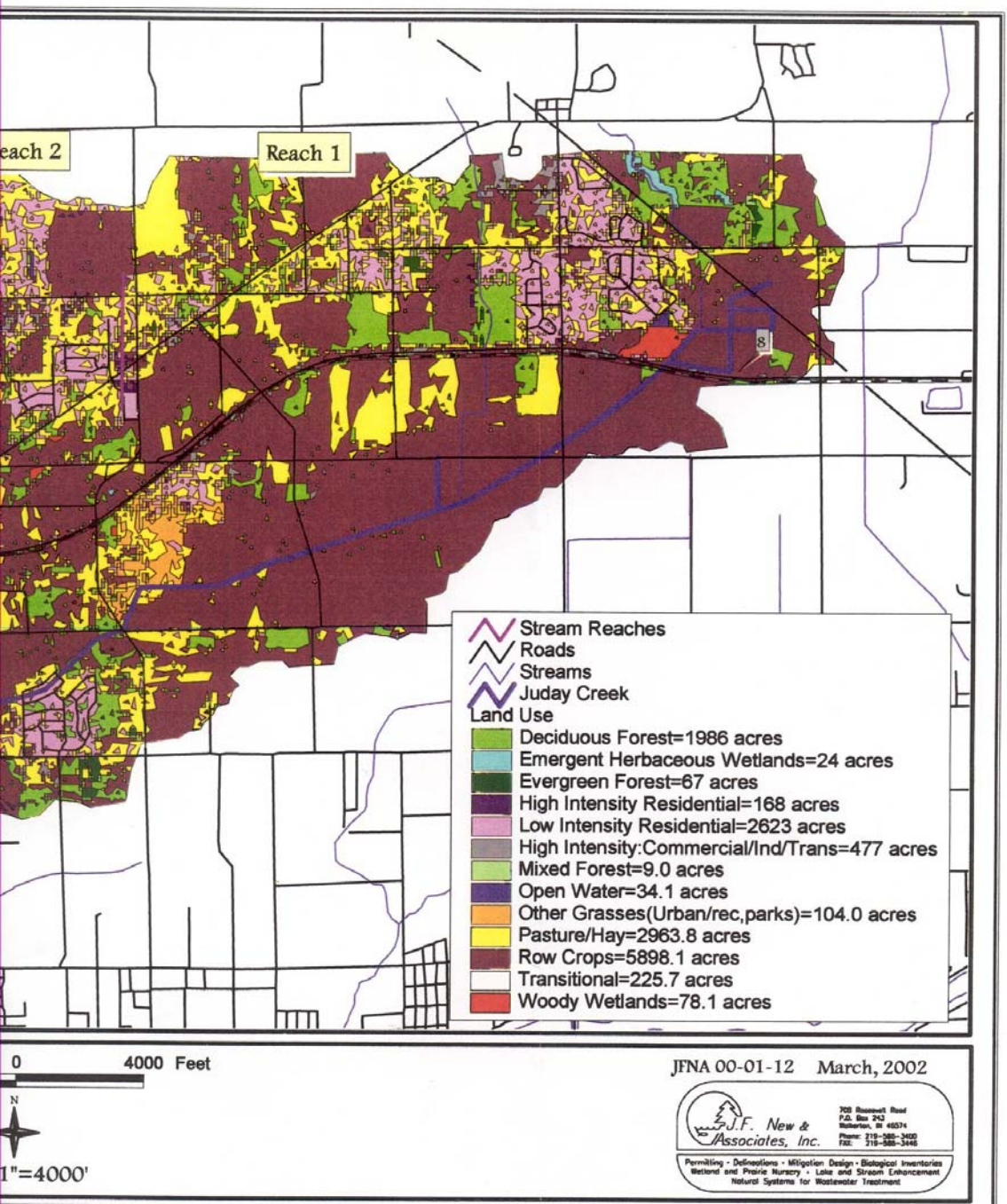


Figure 2: Land Use
Juday Creek Feasibility Study
St. Joseph County, Indiana


each 2
Reach 1
8
Stream Reaches
Roads
Streams
Juday Creek
Land Use
Deciduous Forest=1986 acres
Emergent Herbaceous Wetlands=24 acres
Evergreen Forest=67 acres
High Intensity Residential=168 acres
Low Intensity Residential=2623 acres
High Intensity:Commercial/Ind/Trans=477 acres
Mixed Forest=9.0 acres
Open Water=34.1 acres
Other Grasses(Urban/rec,parks)=104.0 acres
Pasture/Hay=2963.8 acres
Row Crops=5898.1 acres
Transitional=225.7 acres
Woody Wetlands=78.1 acres
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1"=4000'
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TABLE 1. Land use in the Juday Creek Watershed.

Land Use	Acres	%
Row crops	5,898	40.0
Pasture/hay	2,964	20.0
Low intensity residential	2,623	18.0
Deciduous forest	1,986	14.0
High intensity: commercial/ind/trans	477	3.0
Transitional	226	1.5
High intensity residential	168	1.0
Other grasses (urban/rec. parks)	104	1.0
Woody wetlands	78	<1
Evergreen forest	67	<1
Open water	34	<1
Emergent herbaceous wetlands	24	<1
Mixed forest	9	<1
TOTAL	**14,658**	**100**

Source: USGS/EROS Indiana Land Cover Data Set, Version 98-12 (updated December 1998)

2.3 SOILS

Soils in the Juday Creek Watershed developed primarily under the influence of deciduous forest vegetation and originated from glacial drift and till. Soils are predominantly loams and sandy loams, which are well drained and have good productivity. See Table 2 for a list of soil series found in the Juday Creek Watershed.

TABLE 2. Soil series in Juday Creek Watershed.

Soil Series	Acres	%
Coloma	9,206	63.0
Maumee	5,452	37.0
TOTAL	**14,658**	**100**

Source: STATSGO Database

Coloma Series

The Coloma series consists of somewhat excessively drained, rapidly permeable soils located on outwash plains and moraines. These soils formed from sandy parent material. Slopes range from 0 to 12 percent.

Maumee Series

The Maumee series consists of deep, very poorly drained, nearly level and depressional soils on outwash plains. These soils are mainly on low depressional flats and along stream channels. They formed in sandy glacial outwash or stream alluvium. Maumee soils have rapid permeability and a low available water capacity. The organic-matter content is high in the surface layer. Runoff is very slow or ponded. The majority of the Maumee soils adjacent to Juday Creek have been drained for farming and subsequently developed for residential or commercial use.

2.5 PREVIOUS PROJECTS

Juday Creek has been the key focus of restoration efforts from numerous public and private agencies in the St. Joseph County region, due primarily to the poor health of its introduced brown trout population. In 1994, the St. Joseph River Basin Commission released a diagnostic summary of the Juday Creek Watershed. Following this release, Cole Associates produced the Juday Creek Watershed Management Plan in October 1995. The study plan identified seven distinct stream reaches, as shown in Figure 3. Cole Associates recommended Best Management Practices in each stream reach. Following the study, various agencies implemented a number of projects in order to improve the health of the Juday Creek. All improvement projects along Juday Creek have been compiled into a single database. Each project has been assigned an arbitrary number for identification purposes. Table 3 presents a list of all projects completed to date, while Figure 3 depicts the location of each project site.

TABLE 3. Juday Creek restoration projects.

Project #	Project Type
1	In-stream habitat improvements (Lunker structures)
2	Stormwater filter
3	Street re-routing/in-stream habitat improvements
4	Retro fit storm lines, construct berms and enhance vegetation
5	Sediment trap, deep water basin
6	Redirect storm line, vegetation strip, enhancement of natural wetland
7	Sediment trap, vegetation strip
8	Redirect storm line, vegetation strip, sediment trap
9	Vegetation strip, redirection of stormwater
10	Sediment trap, vegetation strip, deep detention basin
11	Retrofit storm lines, sediment trap, constructed wetland
12	Retrofit storm lines, sediment trap, constructed wetland
13	Wetland filter
14	Vegetate stream banks
15	Mitigation Wetland
16	Constructed wetland, stormwater filter
17	Lunker/log treatment
18	Stream bank improvement, in-stream habitat, stream buffer
19-55	Bank stabilization/erosion control (biologs)

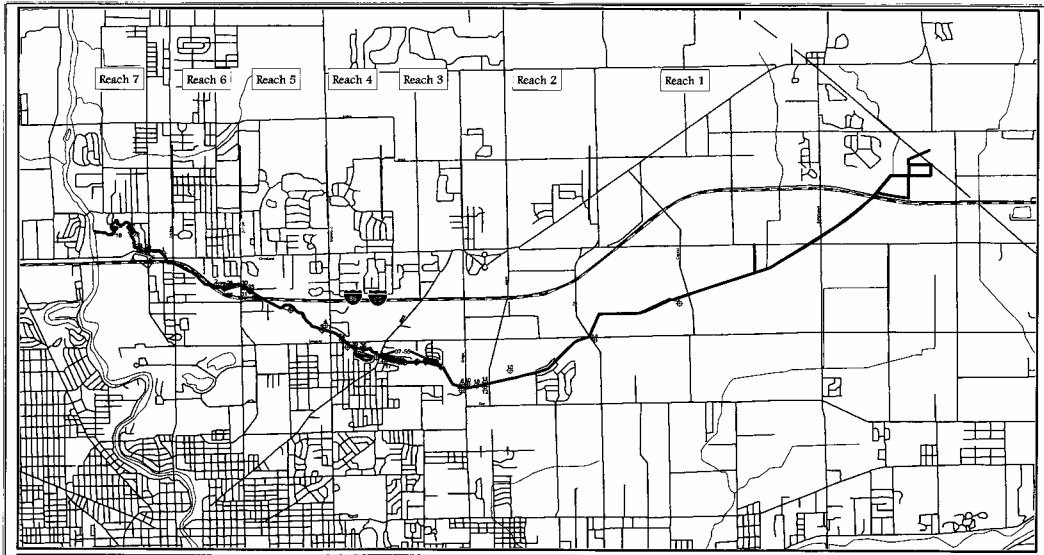
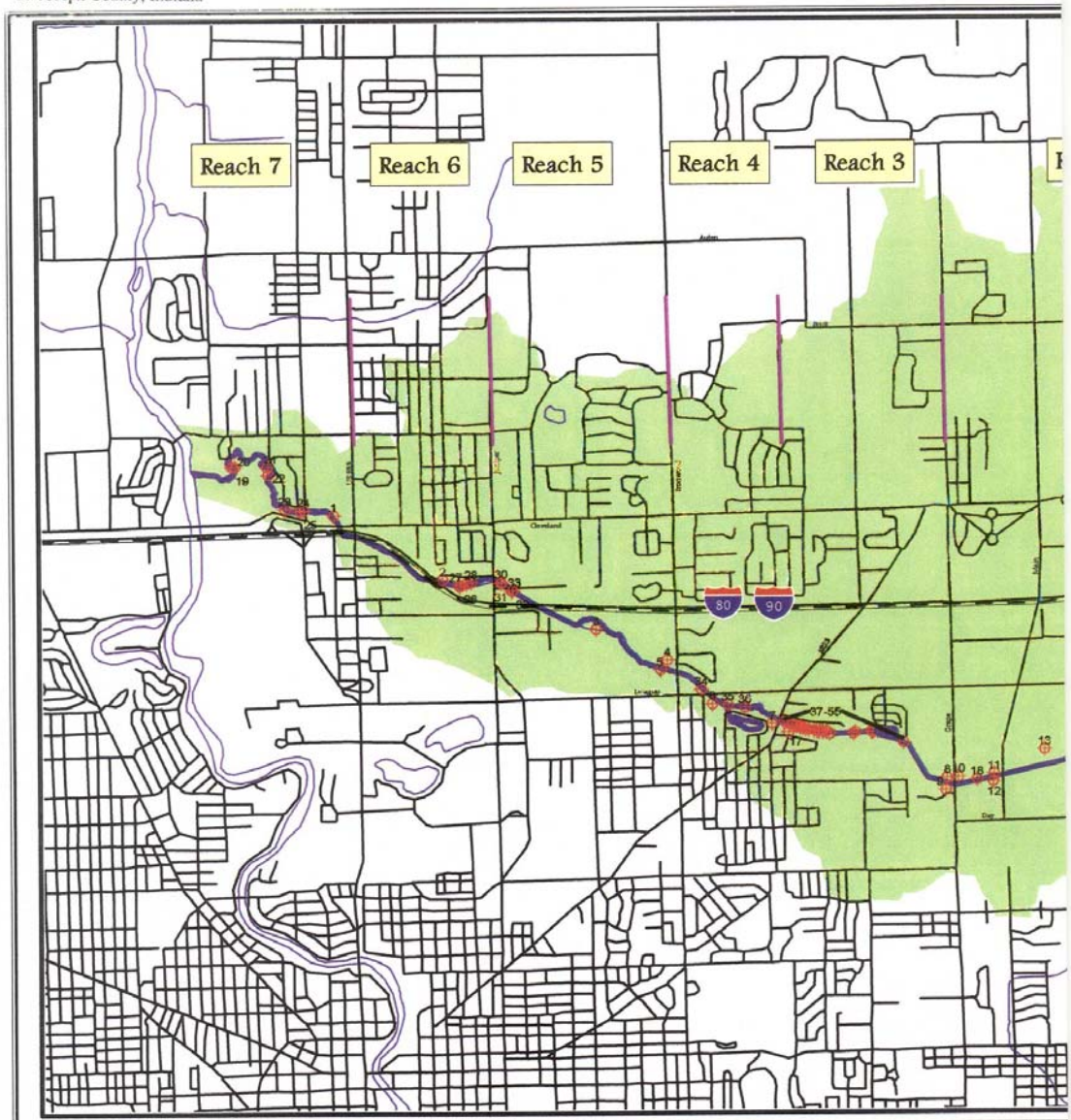


Figure 3: Completed Projects
Juday Creek Feasibility Study
St. Joseph County, Indiana



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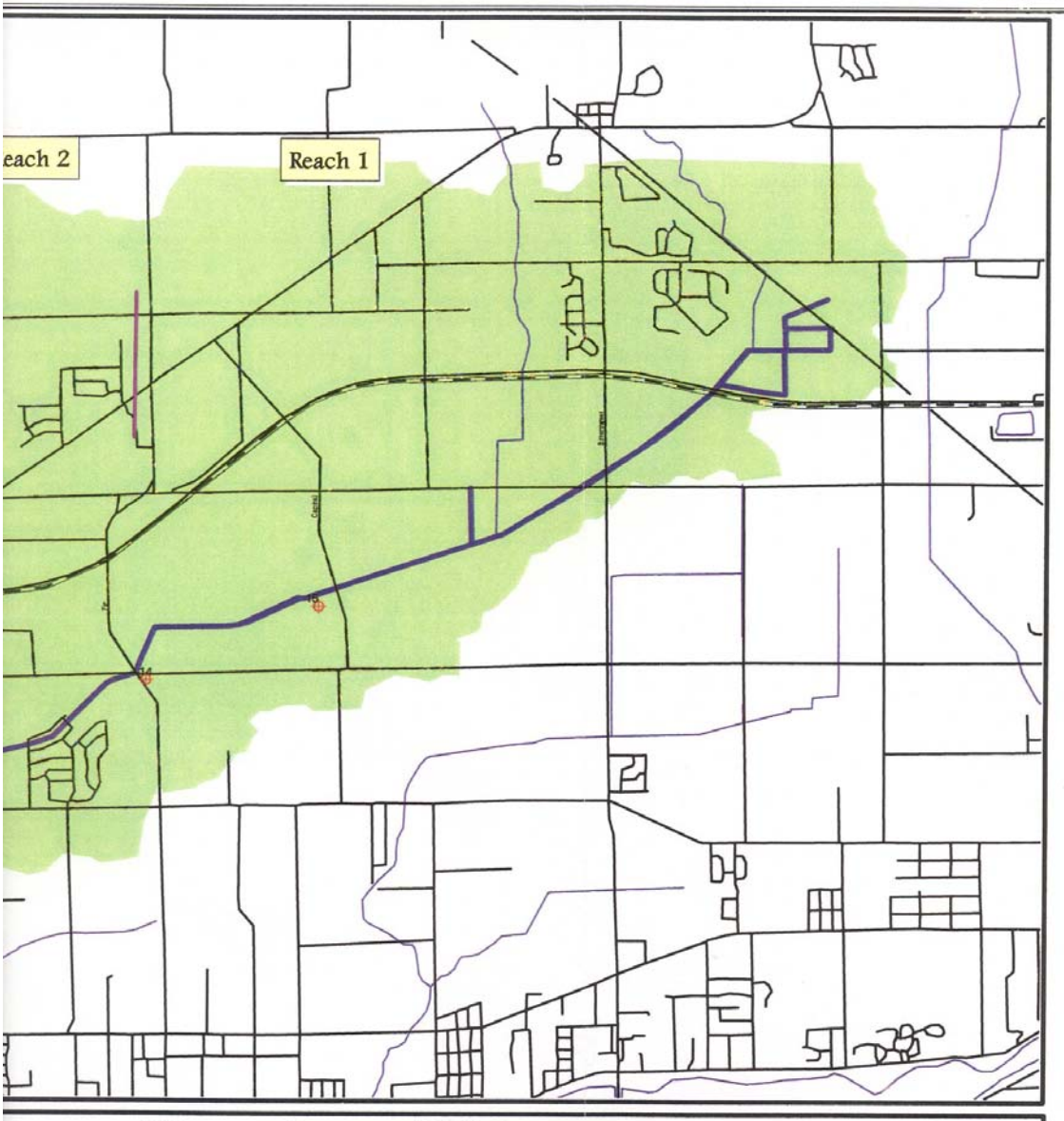
Reach 2
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2.6 PRIOR STUDIES ON JUDAY CREEK

Agencies including Limno-Tech, Inc., University of Notre Dame, U.S. Geological Survey, Cole Associates, Indiana Department of Natural Resources, J.F. New and Associates, Inc., and the City of Elkhart have completed studies to aid in the ecological restoration of Juday Creek. The following list summarizes these studies.

A. Limno-Tech, Inc. studied the potential thermal impacts of detention basins along Juday Creek (Limno-Tech, 1991).

B. The University of Notre Dame Department of Civil Engineering and Geoscience (CE/GEOS) studied the effects of groundwater on the stream (Silliman, 1994). This study involved the installation of groundwater wells at various locations along the stream. Researchers examined the physical and chemical qualities of the groundwater and recorded groundwater depth during various time periods.

C. The University of Notre Dame Department of Biology (BIOS) conducted physical and biological surveys at 10 locations along Juday Creek (Runde, 1994). The study focuses on determining the present and future habitability of trout and macroinvertebrates.

D. The U.S. Geological Survey installed a stream gage to monitor flow and discharge from Juday Creek into the St. Joseph River (Fowler and Wilson, 1995).

E. Cole Associates, Inc. produced a watershed management plan for the Juday Creek watershed (Cole Associates, Inc., 1995). The plan reviews old studies, lists management goals, recommends Best Management Practices, and presents implementation strategies.

F. The Natural Resources Conservation Service conducted an evaluation to assess erosion on a stretch of the stream in the northeast ¼ of Section 32, Township 38N, Range 3E of Clay Township on St. Joseph County.

G. J.F. New and Associates, Inc. conducted a biological survey to examine the effects of in-stream habitat improvements on fish and macroinvertebrate communities adjacent to commercial development along US 933 (J.F. New and Associates, unpublished).

H. J.F. New and Associates, Inc. conducted a study of the stormwater discharges to Juday Creek (J.F. New and Associates, Inc., unpublished). The study suggests discharge alternatives and remediation strategies for nine sites along the stream.

I. J.F. New and Associates, Inc. conducted a biological survey at two locations in Juday Creek to examine the existing fish, macroinvertebrate, and botanical communities prior to construction of Best Management Practices (J.F. New and Associates, Inc., 2001).

J. In 2001, during the production of this document, the City of Elkhart – Waste Water Treatment Plant, under contract with the City of South Bend, conducted a fisheries survey of Juday Creek (Joe Foy, personal communication). The survey results were not available as of this printing.

3.0 RECOMMENDED PROJECTS/FEASIBILITY ANALYSIS

3.1 STABILIZATION/HABITAT IMPROVEMENT WEST OF BROOKTRAILS DRIVE

3.1.1 Site Description and Alternatives

A 720-foot stretch of Juday Creek flows north through residential property just west of and parallel to Brooktrails Drive, approximately 500 feet north of Cleveland Road in stream Reach 7 (Figure 1). The field survey of Juday Creek (Appendix B) noted localized bank erosion, a seawall, streamside ponds, and a poorly vegetated buffer zone. Localized bank erosion is occurring due to poorly vegetated banks. A seawall minimizes bank erosion, but decreases aesthetic value and offers little habitat for fish and macroinvertebrates. A channel on the west side of the stream flows through two ponds then discharges back into Juday Creek. The ponds have accumulated silt to a maximum depth of two feet. These ponds release warmwater to the stream and do not support high quality fish communities. A poorly vegetated buffer zone in this reach offers excellent geese habitat.

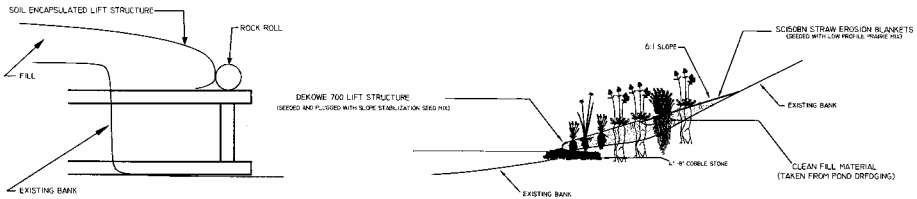
The alternative treatment types considered include:

1. Correct localized instabilities using biolog installations.
2. Correct bank erosion using riprap.
3. Correct instabilities using bioengineered techniques
4. No action.

Alternative 1 involves the installation of vegetated biologs to reduce bank erosion. This alternative is feasible but would require that landowners refrain from mowing to the stream's edge. Biolog installations may reduce bank erosion. The field survey of Juday Creek (Appendix B) revealed that at best, biologs are marginally effective at improving fish or macroinvertebrate habitat. Under Alternative 2, riprap would be placed along the banks within the entire project reach. This option is feasible but reduces aesthetic value and does not alleviate the poorly vegetated buffer zone. Alternative 3 involves stabilizing all priority areas within the study reach using techniques such as glacial stone armor, weirs, grade controls, bioengineered techniques (soil-encapsulated lifts), and lunker structures. Additionally, buffer zones and pond outlets would be planted with a low profile prairie seed mix, shrubs, and emergent wetland vegetation. Alternative 3 would virtually eliminate erosion from the study reach, minimize geese grazing, and provide habitat for fish and macroinvertebrates. Alternative 4 is also feasible. Under this alternative, banks will continue to erode, ponds will continue to release thermal pollutants, and aquatic habitat will remain poor. These considerations indicate Alternative 3 is the best alternative for treating the observed problems at this location.

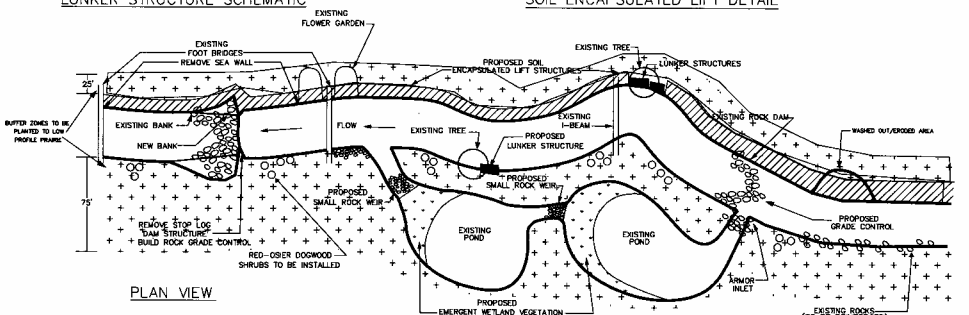
3.1.2 Preliminary Design

Alternative 3 corrects all priority areas within the study reach (Figure 4). Glacial stone armor placed around localized erosion at the channel inlet to the south pond and an existing footbridge will eliminate further erosion. Small rock weirs constructed at the channel between the south and north ponds and outlet to Juday Creek will reduce erosion and create riffle habitat beneficial



LUNKER STRUCTURE SCHEMATIC

SOIL ENCAPSULATED LIFT DETAIL



PLAN VIEW

FIGURE 4: Bank Stabilization and Habitat Improvement
Juday Creek Feasibility Study
PROJECT: Stabilization/Habitat Improvement West of Brooktrails Drive
St. Joseph County, Indiana

J. F. New & Associates, Inc.
Permitting • Delineations • Mitigation Design • Wetland Nursery • Natural Systems for Wastewater Treatment Engineering

DRAWN BY:	BRM
DESIGNED BY:	JR
CHECKED BY:	
DATE:	February 27, 2002
JOB NO:	00-01-12
SCALE:	NONE

to fish and macroinvertebrates. Two strategically placed grade control structures will slow water velocity, reducing bank erosion upstream. An existing seawall on the east bank will be removed and replaced with soil-encapsulated lifts planted with a bank stabilization seed mix. Clean fill material taken from pond dredging will be used to construct the lifts. After dredging, the ponds will have a maximum depth of 10 feet, a more suitable depth for warmwater, lentic fish species. Two lunker structures placed near existing streamside trees will function as artificial undercut banks, a natural stream feature and excellent fish attractor. A 25-foot buffer zone on the east bank and 75-foot buffer on the west bank planted with a low profile prairie seed mix will minimize geese grazing and stabilize the bank soils. Additionally, emergent vegetation planted near pond outflows will filter nutrients from water before entering Juday Creek.

3.1.3 Permit Requirements

The proposed project requires four permits before construction can begin. Approval is needed from the U.S. Corps of Engineers (CORPS), the Indiana Department of Environmental Management (IDEM), the Indiana Department of Natural Resources (IDNR), and the St. Joseph County Drainage Board. See Appendix D, subsections 1 and 2 for state and federal agencies' comments regarding the project. Permits will likely take six months to one year to obtain. Permit application forms can be found in Appendix C.

3.1.4 Landowner Agreements

The landowner has verbally agreed to the project.

3.1.5 Social Costs

The proposed alternative has several unusual social costs associated with the construction process and the end result. The landowner will need to evaluate whether the change in the view of the creek would be positive or negative. Fishing opportunities in the stream and ponds could increase. Some trees may be removed or damaged as part of the construction process. Noise levels will increase during the construction period. Construction equipment may damage maintained lawns. During the construction period, storage of materials including rock, earth, fabric, straw, and vehicles will affect the property aesthetics. The existing septic system in the lawn must be marked and avoided during the construction phase. A thorough survey of the area prior to design will help avoid future problems.

3.1.6 Environmental Assessment

Historical surveys documented fish and macroinvertebrate communities downstream from the proposed project site. Runde (1994) surveyed the fish and macroinvertebrates at two locations on the Izaak Walton League property and found no endangered, threatened, or rare (ETR) species. Lamberti and Berg (1995) also conducted fish and macroinvertebrate surveys on the Izaak Walton League property. They found no ETR species that might be affected by work upstream. It is expected that during project construction, there will be temporary negative impacts to biological communities such as silt deposition and removal of existing vegetation. After construction, the project is expected to positively benefit biological communities by reducing sediment loads and stabilizing bank soils. Additional aquatic habitat and planting of native vegetation should provide areas that support more fish, macroinvertebrates, and botanical species than what currently exists.

3.1.7 Cost Estimate

Bank stabilization/habitat improvement at the project site is expected to cost $106,724 (Table 4).

TABLE 4. Bank stabilization/habitat improvements cost estimate.

Item	Cost	Unit	Quality	Total
Low profile prairie mix	$4,500	Installed	1	$4,500
Red-osier dogwood	$30	Per plant	20	$600
Soil-encapsulated lifts	$75	Per foot	720	$54,000
Glacial stone	$25	Cubic yard	274	$6,850
Excavate ponds/fill material	$7	Cubic yard	100	$700
Erosion and sediment control	$2,500	Lump sum	1	$2,500
Mobilization/demobilization	$2,000	Lump sum	1	$2,000
Construction sub-total				**$71,150**
Engineering, design, and permitting	15%	Construction costs		$10,672
Construction oversight	10%	Construction costs		$7,115
Contingency	25%	Construction costs		$17,787
Total				**$106,724**

3.2 EROSION CONTROL SURROUNDING STORMWATER OUTLET AT KENILWORTH ROAD

3.2.1 Site Description and Alternatives

Kenilworth Road is a residential street maintained by the St. Joseph County Highway Department. The road crosses Juday Creek approximately 250 feet north of Cleveland Road in stream Reach 7 (Figure 1). The field survey of Juday Creek (Appendix B) noted that 60 square feet of bank has eroded away around a stormwater outlet pipe on the northwest side of Kenilworth Road. The bank has eroded back to the next section of a 24- inch concrete drainage pipe, leaving the first section lying on the stream bottom. The erosion is most likely caused by the discharge of stormwater from the concrete pipe and the subsequent turbulence within Juday Creek.

The alternatives considered for fixing this erosion area include:

1. Placing the collapsed section of pipe on top of a riprapped stabilized toe and resloping and seeding the bank above the pipe.
2. Placing a concrete or sheet pile head wall at the original bank location, backfilling and replacing the collapsed section of pipe.
3. No action.

Alternative design 1 provides the most stability while creating a natural bank appearance. Alternative 2 is feasible but reduces aesthetic value and does not improve habitat. Alternative 3 is also feasible. Under this option, erosion will continue around the stormwater outlet pipe. A review of the three alternatives indicates Alternative 1 is the best option for treating the eroding stormwater outlet.

3.2.2 Preliminary Design

Under Alternative design 1, the outlet pipe will be stabilized with riprap while the banks will be planted with deep-rooted vegetation. Figure 5 depicts a plan view of the riprap base, which extends into Juday Creek 1.5 feet. Figure 6 represents a cross section of the pipe extension and regarding plan. The riprap extension acts as a groin to push the current away from the outfall, thereby reducing the turbulence. The riprap will be underlain by a non-woven geotextile liner to prevent ground water discharge from leaching through the riprap. The collapsed section of pipe will be seated directly on the riprap and held in place by topsoil graded to a 3:1 slope from the invert to the top of the existing bank. The slope will be seeded with a mix of grasses that have deep and extensive root systems for long-term stabilization. The seed is held in place by a coconut and straw erosion control blanket installed per the manufacturer recommendations.

3.2.3 Permit Requirements

A construction in a floodway permit is typically required for all work in a regulated floodway such as Juday Creek. Assuming the St. Joseph County Drainage Board performs the work, it will be considered maintenance of an existing drain and will not require permits from IDNR, the CORPS, or IDEM. If the St. Joseph County Drainage Board does not perform the work, the CORPS has jurisdiction over Juday Creek as a "waters of the United States". The CORPS has issued Regional General Permits (RGP) for minor activities (0.10 acres or less) within its jurisdiction. This project qualifies for a RGP and must be submitted to IDEM and IDNR. IDEM requires that projects within "waters of the state" that "discharge pollutants" (including fill) get authorization from the agency under Section 401 or 402 of the Clean Water Act. This project meets the requirements for notification under Section 401 water quality certification. Notification only requires a 15-day waiting period. The notification form is attached in Appendix C. The St. Joseph County Drainage Board will need to approve this project, as Juday Creek is a legal drain. See Appendix D, subsections 1 and 2 for state and federal agencies' comments regarding this project.

3.2.4 Landowner Agreements

The project is within the St. Joseph County Drainage Board's jurisdiction. The Drainage Board has verbally agreed to complete the project with its own funding.

3.2.5 Social Costs

There are limited social costs associated with this project. It is a one-day project requiring no long-term maintenance. There may be some temporary disturbance caused by installing the filter fabric and riprap, but this disturbance is expected to be limited.

3.2.6 Environmental Assessment

A plant survey of the area found no restorable vegetation. Adjacent vegetation includes silky dogwood and lawn grasses. Only the lawn grasses will be impacted by the project. Runde (1994) surveyed macroinvertebrates at Kenilworth Road as part of Notre Dame's biological reconnaissance of Juday Creek. The study found no ETR macroinvertebrate species that might be affected by construction work within the stream. Runde (1994) and Lamberti and Berg (1995) collected macroinvertebrates and fish downstream of Kenilworth Road on the Izaak Walton League property and found no ETR species that might be affected by work upstream. This project is expected to have a minimal positive affect on fish and macroinvertebrates by creating additional habitat.

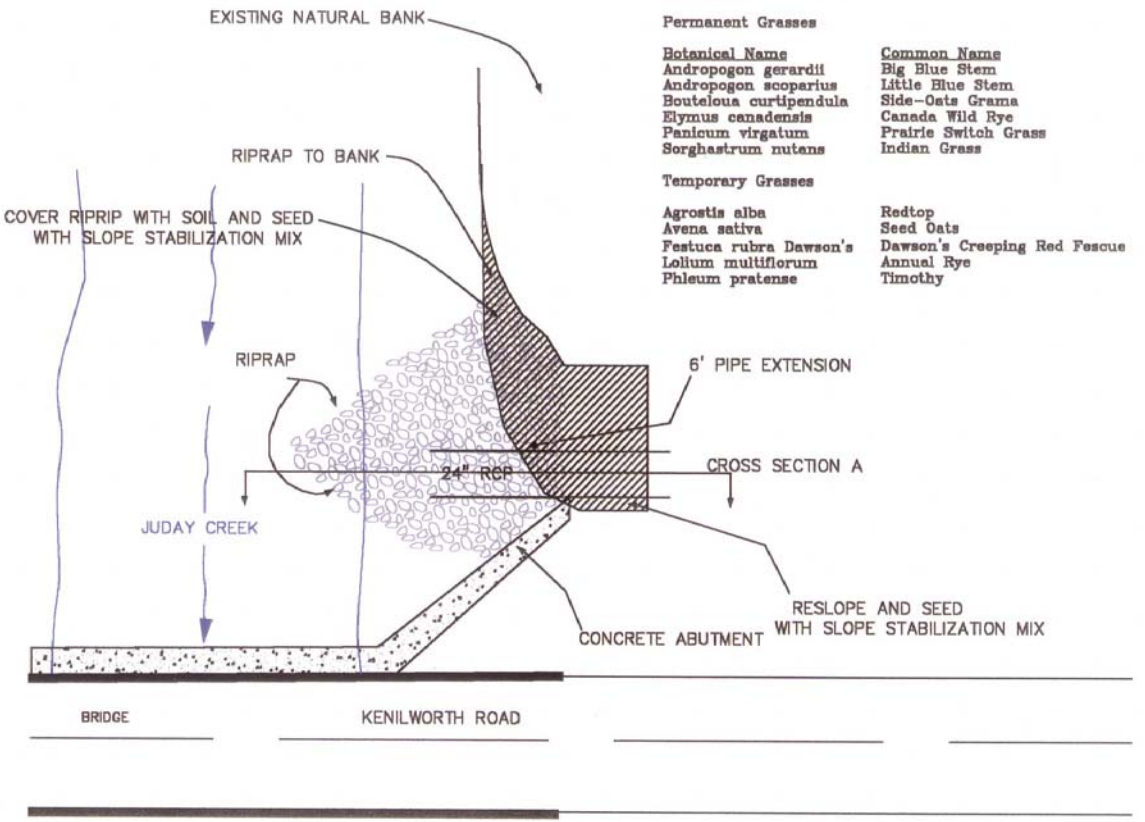


FIGURE 5: Plan View– Pipe Extension and Regrading
Juday Creek Feasibility Study
PROJECT: Erosion Control Surrounding Stormwater Outlet at Kenilworth Road
St. Joseph County, Indiana

J.F. New & Associates, Inc.
Permitting · Delineations · Mitigation Design · Wetland Surveys · Natural Systems for Wastewater Treatment Engineering

DRAWN BY: BRM
DESIGNED BY: JR
CHECKED BY:
DATE: February 27, 2002
JOB NO: 00-01-12
SCALE: NONE

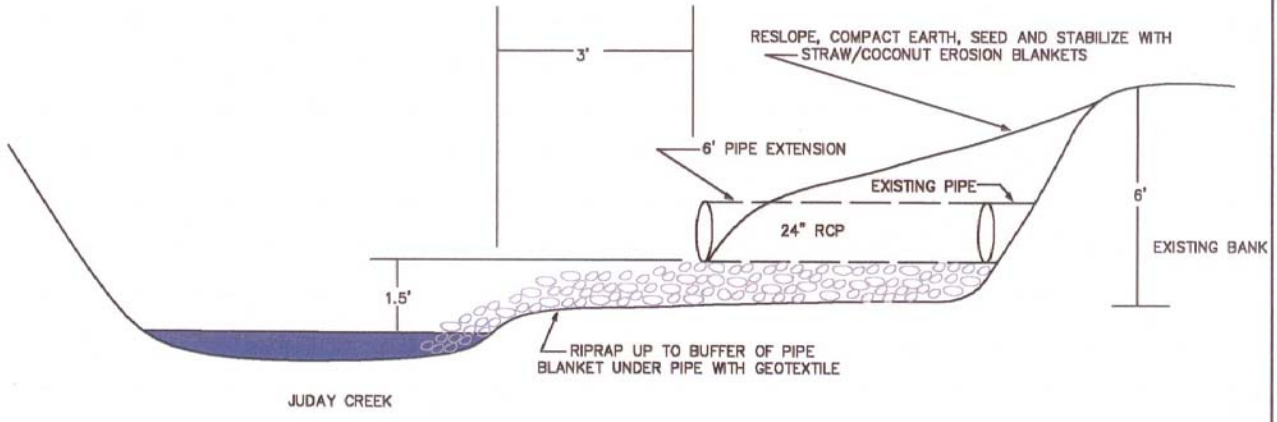


FIGURE 6: Cross Section--Pipe Extension and Regrading
Juday Creek Feasibility Study
PROJECT: Erosion Control Surrounding Stormwater Outlet at Kenilworth Road
St. Joseph County, Indiana

J. F. New & Associates, Inc.
Permitting - Delineations - Mitigation Design - Wetland Nursery - Natural Systems for Wastewater Treatment Engineering

DRAWN BY:	BRM
DESIGNED BY:	JR
CHECKED BY:	
DATE:	February 27, 2002
JOB NO:	00-01-12
SCALE:	NONE

3.2.7 Cost Estimate

The probable cost of construction at Kenilworth Road, assuming the work is completed under the supervision of the St. Joseph County Drainage Board, is $750 (Table 5).

TABLE 5. Kenilworth Road cost estimate.

Item	Cost	Unit	Quantity	Total
Excavation/hauling	$8.50	Cubic yard	12	$100
Rip-rap	$20	Ton	10	$200
Back fill	$10	Ton	15	$150
Coconut straw fabric	$200	1 roll (installed)	1	$200
Seed	$50	Lump sum	1	$50
Staples	$50	Lump sum	1	$50
Total				**$750**

3.3 STREAM REROUTE/WETLAND FILTER (SOUTHEAST SIDE OF INTERSTATE 80/90 AT US 933)

3.3.1 Site Description and Alternatives

Juday Creek flows west approximately 200 feet south of and parallel to Interstate 80/90, approximately 20 feet north of the Hospice of St. Joseph County in stream Reach 7 (Figure 1). The field survey (Appendix B) noted several stormwater outlets originating from parking lots and US 933. Collectively, these outlets deliver unfiltered stormwater into Juday Creek.

The alternative treatment types considered include:

1. Gravel/sand filters at the spillways.
2. Mechanical in-line separators or filtration bags.
3. Stream reroute and wetland filter.
4. No action.

A lack of space for several of the intended discharge points renders Alternative 1 infeasible. Alternative 2 is not feasible because it is cost prohibitive and requires long-term frequent maintenance. Alternative 3 is feasible. Water quality benefits resulting from a stream reroute/constructed wetland filter include reduced sediment, thermal pollution, road salts, and petroleum products. The proposed project under this option provides the most benefit to the stream's health for the lowest long-term cost. Alternative 4 is also feasible but does not improve water quality in the stream. Analysis of the four alternatives revealed Alternative 3 as the best option.

3.3.2 Preliminary Design

A stream reroute/wetland filter provides a natural look, blends into the environment, and requires little maintenance. Figures 7 and 8 depict conceptual and cross sectional plan views of the stream reroute/wetland filter and some additional streambank erosion control and enhancement upstream. To avoid removing buildings, approximately 300 feet of Juday Creek will need to be routed north of its current alignment just east of US 933. The stream will be rerouted using the

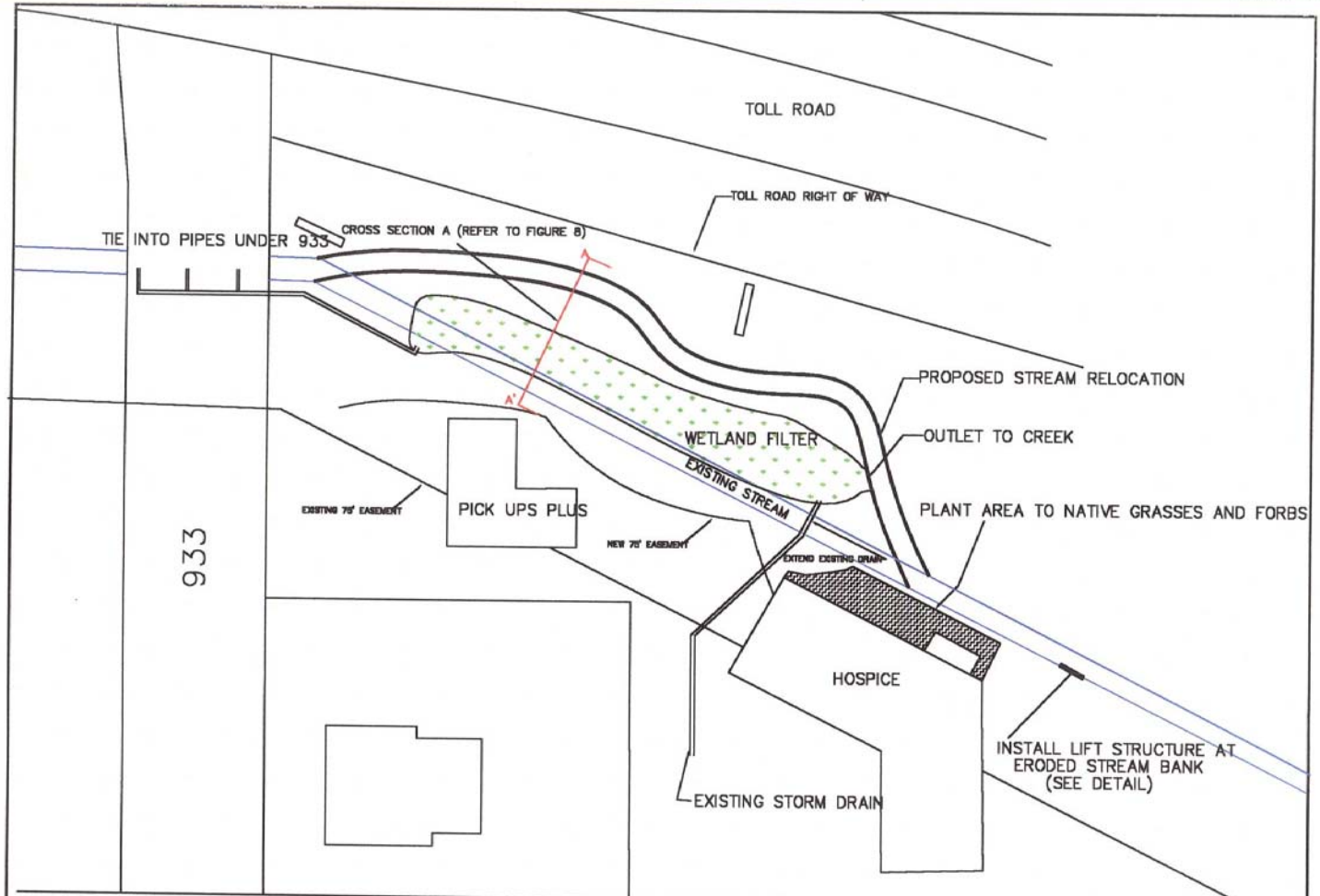


FIGURE 7: Plan View-- Stream Reroute/Wetland Filter
Juday Creek Feasibility Study
PROJECT: Stream Reroute/Wetland Filter (Southeast side if I80-90 at US 933)
St. Joseph County, Indiana

J. F. New & Associates, Inc.
Permitting · Delineations · Mitigation Design · Wetland Nursery · Natural Systems for Wastewater Treatment Engineering

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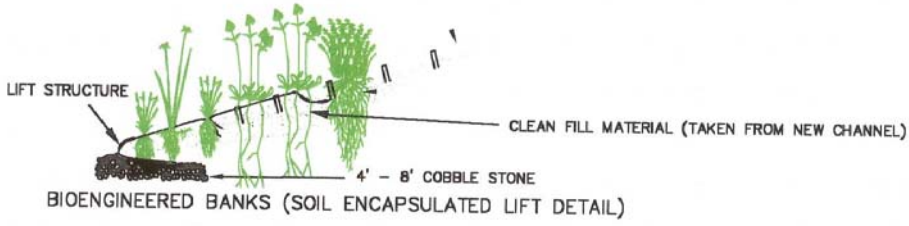
DESIGNED BY:	JR
CHECKED BY:	
DATE:	February 27, 2002
JOB NO:	00-01-12
SCALE:	NONE



BIOENGINEERED BANKS (SOIL ENCAPSULATED LIFT DETAIL)

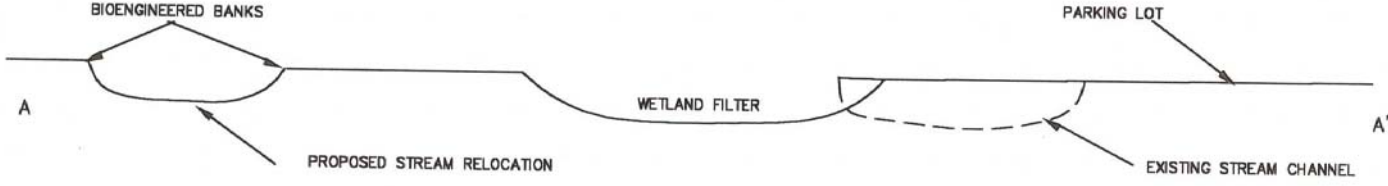


FIGURE 8: Cross Section A ––Wetland Filter
Juday Creek Feasibility Study
PROJECT: Stream Reroute/Wetland Filter (Southeast side of I80–90 at US 933)
St. Joseph County, Indiana

J. F. New & Associates, Inc.
Permitting · Delineations · Mitigation Design · Wetland Nursery · Natural Systems for Wastewater Treatment Engineering

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JOB NO:	00-01-12
SCALE:	NONE

design concepts and parameters utilized in the Notre Dame Golf Course project upstream. The stormwater will be routed from current discharge points along US 933 and the Hospice Center parking lot into a 30 to 50-foot wide by 250-foot long gravel bottom constructed wetland. The constructed wetland filter will drain eastward to discharge to Juday Creek. These filtration wetlands typically remove up to 90% of the solids and 45-75% of the phosphorus, nitrogen, and petroleum compounds (Cooke et al., 1993). Additional design plans will be required to proceed with the project.

3.3.3 Permit Requirements

This project will require the approval of IDNR, IDEM, CORP, and the St. Joseph County Drainage Board. See Appendix D, subsections 1 and 2 for state and federal agency's comments regarding the project. Permit application forms can be found in Appendix C.

3.3.4 Land Owner Agreements

B & R Oil Company owns the land on which the proposed wetland would lie. The owner of B & R Oil generally supports the project. See Appendix D, subsection 3B for communication between New and B & R Oil Company.

3.3.5 Social Costs

The loss of available land is the only social cost associated with this project. The land north of the stream to Interstate 80/90 is currently unused; it lies in a regulated floodway. The wetland filter will be constructed in or adjacent to the north side of the existing Juday Creek channel. This may benefit the owner of the property by allowing the use of more ground on the south side of the existing stream. Construction access will be gained through the existing developed B & R Oil company property on the south side of the stream. Construction of the new channel will cause temporary loss of parking and stream crossing. Additionally, some trees may be lost through the construction process. Overall, the project will result in improved fish and macroinvertebrate habitat, more useable space, and improved water quality.

3.3.6 Environmental Assessment

J.F. New & Associates surveyed fish, macroinvertebrates, and vegetation approximately 700 feet downstream from the proposed project site (J.F. New and Associates, unpublished). The study found no endangered or threatened species that will be impacted by construction upstream. The existing project site has good riparian habitat value with the shrubs and trees present along the banks. However, the bottom of the stream is not vegetated, has no riffle or pool structure, and is dominated by sand. Initial construction is expected to have little effect on fish, macroinvertebrate, or plant communities downstream. Post construction conditions are expected to increase habitat value in the relocated stream by providing riffle-pool and well vegetated riparian habitat. Additionally, the project will improve water quality downstream by removing sediment and nutrient loads from stormwater before they enter Juday Creek.

3.3.7 Cost Estimate

The stream reroute/wetland filter is expected to cost $167,400 (Table 6).

TABLE 6. Stream reroute/wetland filter cost estimate.

Item	Cost	Unit	Quantity	Total
Channel reconstruction	$125	Per foot	300	$37,500
Filter construction	$125	Per foot	200	$25,000
Piping of storm water	$50	Per foot	200	$10,000
Install boulders to protect road grade	$50	Per foot	90	$4,500
Erosion and sediment control	$ 5,000	Lump sum	1	$5,000
Mobilization/demobilization	$ 2,000	Lump sum	1	$2,000
Construction sub-total				**$84,000**
Services during construction	10%	Construction	$84,000	$8,400
Contingency	25%	Construction	$84,000	$21,000
Engineering design and permitting	30%	Construction	$84,000	$25,200
Total				**$138,600**

3.4 STREAM RECONSTRUCTION/WETLAND FILTER BETWEEN IRONWOOD AND DOUGLAS ROADS

3.4.1 Site Description and Alternatives

A 1,200-foot stretch of Juday Creek flows northwest largely through residential property between Ironwood and Douglas Roads in stream Reach 4 (Figure 1). The field survey of the stream (Appendix B) noted bank erosion, a sand bottom, and several streamside ponds. Unstable banks in one meander threaten one home's foundation, while streamside ponds act as sources of thermal pollution to the stream. The erosion of both banks and the lack of habitat in the stream channel are a result of sediment deposition and poor riparian vegetation. Within this project reach, Juday Creek flows northwest and crosses Douglas Road approximately 800 feet east of the intersection of Douglas and Ironwood Roads. The field survey of Juday Creek (Appendix B) noted severe erosion around a stormwater outlet that drains water from the north side of Douglas Road into the stream. The outlet is a concrete spillway that connects to Douglas Road at a curb cut just west of the bridge over the stream. The spillway slopes to a steel sheet pile at the waters edge. Stormwater that travels down the concrete spillway scours the area around the spillway. The scour extends to at least three feet beneath the pavement surface of Douglas Road.

The alternative treatment types considered include:

1. Stabilize priority areas using techniques such as glacial stone, coconut fiber logs planted/seeded with native vegetation, and woody debris structures.
2. Reconstruct the entire project area by narrowing the channel, restoring meanders, constructing pool habitat, reshaping, and revegetating the banks with native plants. Included in this option is a constructed wetland filter for Douglas Road.
3. Connect the runoff on the north and south sides of Douglas Road and route it to an existing wetland basin at the southeast corner of Douglas and Maple Roads.
4. No action.

Several agencies have implemented Alternative 1 with varying degrees of success throughout the length of Juday Creek. The bank stabilization techniques included in this alternative do not improve habitat for fish and macroinvertebrates. Alternative 2 would completely reconstruct the stream using design techniques similar to those implemented in the Notre Dame Golf Course channel relocation project. These methods produce the best response in terms of improving stream habitat and reducing erosion. Additionally, a wetland filter constructed on the north side of Douglas Road on property owned by the McBrides will remove the sand, salt, and other pollutants that wash off Douglas Road. Alternative 3 involves routing stormwater from the north side of Douglas Road to an existing basin on the south side of the road. This option is not feasible due to the lack of fall between the north side of Douglas Road and the existing basin. Under Alternative 4, the banks would continue to erode and may ultimately damage a home where flows have begun to undermine the foundation. Douglas Road would also remain unsafe with its current stormwater outlet structure. In addition, fish and macroinvertebrate habitat would remain poor and water quality would not improve. These considerations suggest Alternative 2 is the best alternative.

3.4.2 Preliminary Design

The bank stabilization and stream reconstruction techniques utilized in this design include narrowing the existing stream channel with bioengineered bank stabilization techniques (soil-encapsulated lifts), filling existing inflow/outflow channels to streamside ponds, filling portions of the existing stream channel, excavating pools on outside meanders, and placing boulders in the bank toe near Ironwood Road (Figure 9). A narrowing of the existing stream channel will increase flow velocity and keep fine sediments moving through the stream. Backfilling existing inflow/outflow channels to streamside ponds will keep them from filling with fine sediments. Excavating the existing ponds to a depth of eight to 10 feet will create a more suitable habitat for warmwater, lentic fish species. Sediment excavated from ponds will be used to fill an existing side channel that presently threatens a home's foundation. Excavated pools on outside meanders will create holding water for selected fish species and encourage sediment sorting. Boulders placed in the bank toe near Ironwood Road will prevent erosion while providing fish habitat.

In addition to stream reconstruction, a small wetland filter/swale (approximately 0.057 acre) will be constructed on the north side of Douglas Road, just west of Juday Creek (Figure 10). The filter will be designed to serve stormwater from the northern half of the 1,200-foot reach to Ironwood Road. It will be vegetated with wetland plants; maintenance will be minimal including annual inspections to check on the capacity of the system and growth of plants. Construction will include working around the largest of the silver maple trees, which dominate the site. Much of the remaining vegetation at the site is reed canary grass and other non-native plants. The filter is designed to remove the majority of solids and from 45-75% of the nutrient load in the stormwater (Cooke et al. 1993).

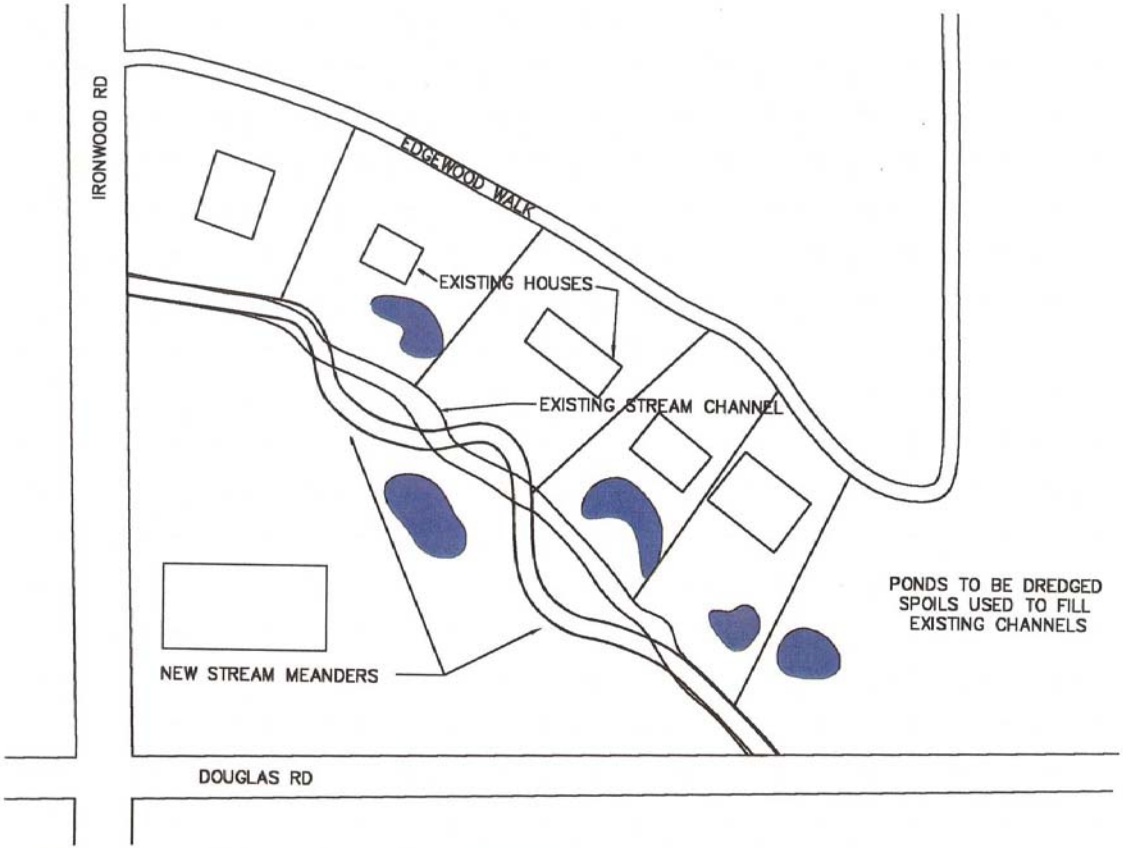

FIGURE 9: Plan View--Stream Reconstruction
Juday Creek Feasibility Study
PROJECT: Stream Reconstruction
St. Joseph County, Indiana

J. F. New & Associates, Inc.

DRAWN BY: STM
DESIGNED BY: JR
CHECKED BY:
DATE: February 27, 2002
JOB NO: 00-01-12
SCALE: NONE

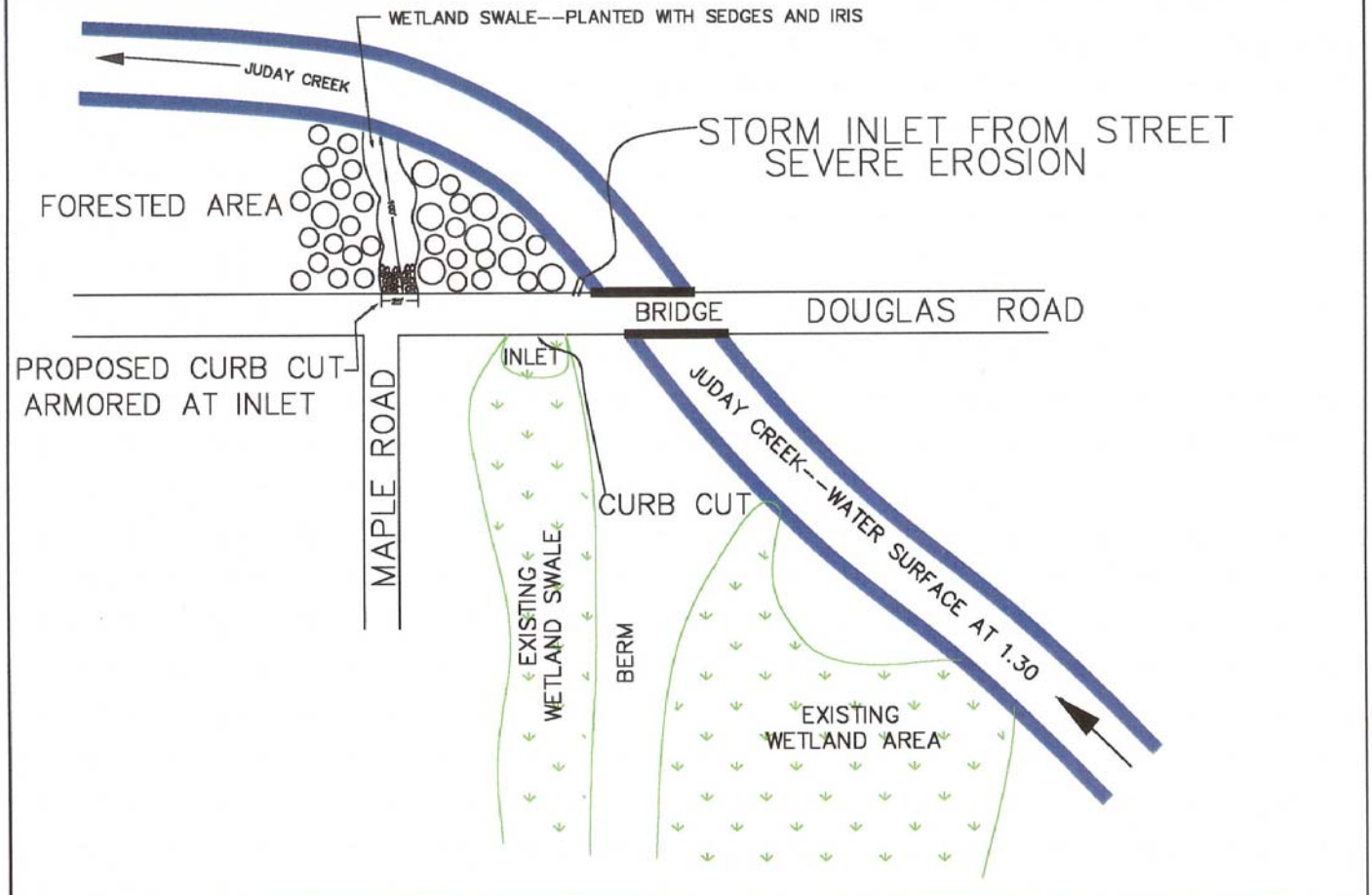

FIGURE 10: Plan View--Wetland Filter
Juday Creek Feasibility Study
PROJECT: Wetland Filter (Douglas Rd)
St. Joseph County, Indiana

J. F. New & Associates, Inc.
Permitting · Subdivisions · Mitigation Design · Wetland Nursery · Natural Systems for Wastewater Treatment Engineering

DRAWN BY:	BRM
DESIGNED BY:	JR
CHECKED BY:	
DATE:	February 27, 2002
JOB NO:	00-01-12
SCALE:	NONE

3.4.3 Permit Requirements

This project will require the approval of the IDNR, IDEM, CORP, the St. Joseph County Drainage Board, and the County Highway Department. Permits will likely take from six months to one year to obtain. Permit applications can be found in Appendix C. Refer to Appendix D, subsections 1 and 2 for state and federal agencies' comments regarding the proposed project.

3.4.4 Landowner Agreements

There are six landowners in the project reach. Five of the landowners live north of Juday Creek on Edgewood Walk. The other landowner lives south of the stream at the northeast corner of Ironwood and Douglas Roads. All landowners have agreed to support the proposed project (Appendix D, subsection 3C).

3.4.5 Social Costs

The proposed alternative for this reach has several unusual social costs associated with the construction process and the end result. Property lines run through the center of the stream, as it exists now or has existed some time in the past. All owners must hire a surveyor to establish permanent property lines that may or may not follow the centerline of a newly aligned channel. Each owner who agrees to this project needs to consider whether the change in his or her view of the creek is positive or negative. Fishing opportunities should increase. Fishing may be considered a positive or negative to each owner. Some trees may be removed or damaged as part of the construction process. Property values should increase especially for the homeowner who has a failing foundation. There will be a temporary noise and people traffic issue during the three to four months of construction that must be considered. Construction equipment may damage maintained lawns. Existing septic systems in these lawns will be marked and avoided during the design phase and construction phase. A survey of these areas prior to design will help avoid future problems. Some fences will need to be repaired at the projects conclusion. Storage of construction materials including rock, earth, fabrics, straw, and vehicles will affect at least one owner's ability to use their property.

3.4.6 Environmental Assessment

J.F. New surveyed the fish, macroinvertebrates, and plants along Juday Creek between Ironwood and Douglas Roads in October 2001 (Appendix E). The study found no ETR species that might be affected by work within the stream. Lamberti and Berg (1995) also surveyed biological communities in a similar residential area and found no ETR species. It is expected that during project construction there will be temporary negative impacts to biological communities. After construction, the project is expected to positively benefit biological communities. A reduction in sediment and heated water discharge, more available fish and macroinvertebrate habitat, and planting of native plant species should provide habitat that supports a more diverse biological community than what currently exists.

3.4.7 Cost Estimate

The probable cost of stream reconstruction and a wetland filter between Ironwood and Douglas Roads is $357,284 (Table 7).

TABLE 7. Probable cost estimate for stream reconstruction/wetland filter (Douglas Road to Ironwood Road).

Item	Cost	Unit	Quantity	Total
Construct new pools for fish habitat	$300	Each	11	$3,300
Soil-encapsulated lifts	$75	Per foot	730	$54,750
Install boulders to protect road grade	$50	Per foot	90	$4,500
Stone	$25	Cubic yard	20	$500
Construct new channel meanders	$125	Per foot	480	$60,000
Excavate ponds/filter for fill material	$7	Cubic yard	2,970	$18,200
Fabric, seed, plugs, and misc. (wetland filter)	$8	Square yard	550	$4,440
Clearing and grubbing (wetland filter)	$2,500	Lump sum	1	$2,500
Install native vegetation throughout reach	$12,000	Per acre	6.5	$78,000
Reclaim access roads, site cleanup	$5,000	Lump sum	1	$5,000
Erosion and sediment control	$5,000	Lump sum	1	$5,000
Mobilization/demobilization	$2,000	Lump sum	1	$2,000
Construction sub-total				**$238,190**
Engineering design, surveying, and permitting	20%	Construction costs	$238,190	$47,638
Construction oversight	10%	Construction costs	$238,190	$23,819
Contingency	25%	Percent	$238,190	$59,547
Total cost				**$369,194**

3.5 POND FILL/CONSTRUCTED STREAM CHANNEL (Douglas Road east of Ironwood Road)

3.5.1 Site Description and Alternatives

The proposed project site, located approximately 1,500 feet upstream of Douglas Road's intersection with Juday Creek includes a residence with several acres of vacant land and frontage along Douglas Road. The site contains an ornamental pond. Water from the stream flows through a side channel into the pond. Over the years, up to two feet of silt has accumulated in the 0.3 acre pond. In dry summers, the pond contains no water. Water from the pond discharges into a neighbor's pond to the west, then into Juday Creek to the south. Thermal pollution from the pond impairs the stream habitat. In addition, due to the pond's shallow depth, it is incapable of supporting fish. The owner approached the study team for solutions.

The alternatives considered included:

1. Completely fill in the ponds and channel.
2. Fill the ponds to the point of maintaining a single channel to the neighbors' ponds.
3. No action.

Alternative 1 would be of the most value to the stream; however, the owner would lose all of the aesthetic value that the waterway/pond add to the residential lot. Alternative 2 would reduce thermal pollution, increase fish habitat, and preserve the aesthetic value of the stream. Alternative 3 would not benefit the stream or the landowner.

3.5.2 Preliminary Design

Alternative 2 will involve filling in the majority of the pond that now exists on the property (Figure 11). A conveyance channel will remain to carry water to the neighbor's pond, who was not contacted during this study. Depending upon the owner's final design choices, the remaining channel on the property will be stabilized with stone or vegetation established on coir fiber lifts. If desired by the landowner and regulatory agencies, gravel could be placed on the bottom of the channel, overhanging trout habitat structures (lunkers) could be built into the banks of the newly established two to three foot wide channel, and native vegetation could be planted on the channel banks. The project is designed to limit the thermal pollution from the ponds. However, habitat improvement is an important secondary goal. Figure 12 represents a conceptual rendering of the completed project.

3.5.3 Permit Requirements

This project will require the approval of the IDNR, IDEM, CORPS, and the St. Joseph County Drainage Board. See Appendix D, subsections 1 and 2 for state and federal agencies' comments regarding the project. Permit application forms can be found in Appendix C.

3.5.4 Landowner Agreements

One landowner will be affected by this proposal. The landowner has agreed to support the project. See Appendix D, subsection 3D for communication between New and the landowner. Adjacent landowners will be involved in final designs and permitting.

3.5.5 Social Costs

The proposed alternative has limited social costs associated with the construction process and the end result. The aesthetic value of the existing pond will be partially or entirely lost depending upon the design chosen. Fishing opportunities will likely change from pond-oriented fish communities to stream-oriented fish communities. It is unlikely that the work will affect property values. Increased noise and people traffic is expected during the one to two month estimated construction time. Construction access is through the owner's maintained lawn. Storage of construction materials including rock, earth, fabrics, straw, and vehicles during the construction period will affect the owner's ability to use the property. Additionally, the existing septic system will be marked and avoided during the design phase and construction phase. At this time, the exact location and condition of the septic system is unknown.

3.5.6 Environmental Assessment

Lamberti and Berg (1995) surveyed biological communities in a similar residential reach of Juday Creek. The study found no ETR species that might be affected by work within the stream. J.F. New also surveyed biological communities including fish, macroinvertebrates, and plants approximately 2,000 feet downstream between Douglas and Ironwood Roads (Appendix E). No ETR species were observed. It is expected that little or no impact will occur during or following construction as the newly constructed channel can be completely sealed off from Juday Creek.

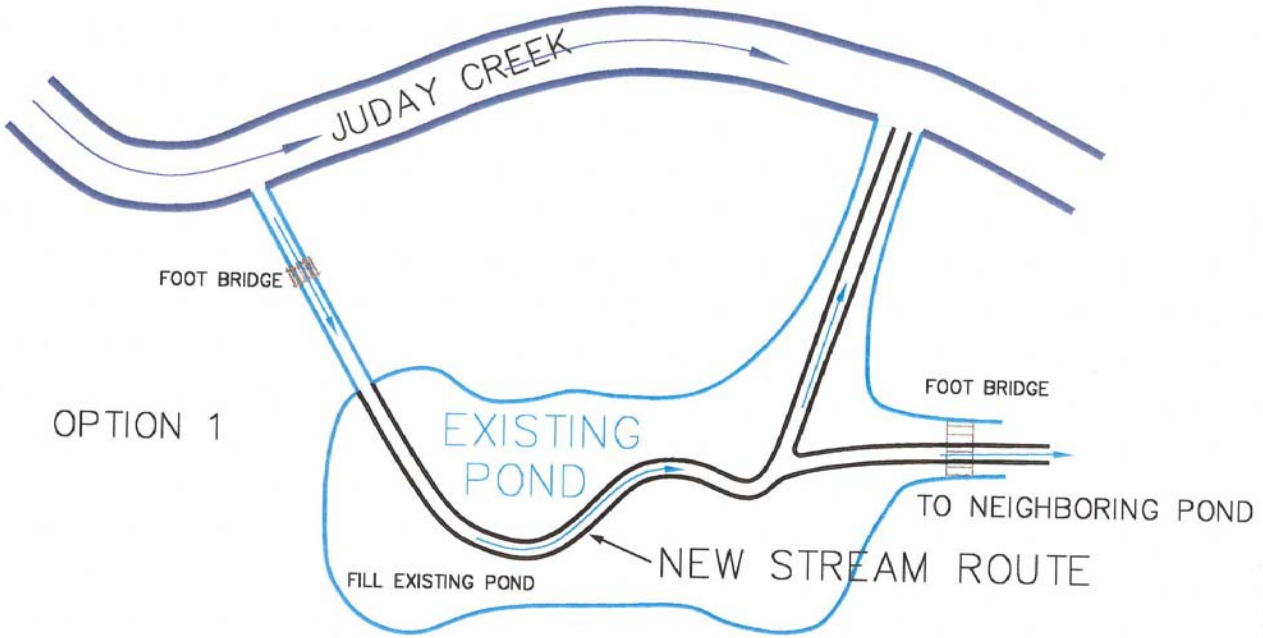

FIGURE 11: Plan View– Pond Fill/Constructed Stream Channel
Juday Creek Feasibility Study
PROJECT: Pond Fill/Constructed Stream Channel (Ziolkowski Property)
St. Joseph County, Indiana

J. F. New & Associates, Inc.
Permitting · Delineations · Mitigation Design · Natural Nursery · Natural Systems for Wastewater Treatment Engineering

DRAWN BY:	BRM
DESIGNED BY:	JR
CHECKED BY:	
DATE:	
JOB NO:	00-01-12
SCALE:	NONE

FIGURE 12: Pond Fill/Constructed Stream Channel Rendering
Juday Creek Feasibility Study
PROJECT: Pond Fill/Constructed Stream Channel (Douglas Road East of Ironwood Road)
St. Joseph County, Indiana

J. F. New & Associates, Inc.
Permitting · Delineations · Mitigation Design · Wetland Nursery · Natural Systems for Wastewater Treatment Engineering

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JOB NO:	00-01-12
SCALE:	NONE

The project's long-term goal is to benefit biological communities by reducing thermal pollutants to the stream, reintroducing native plant species to the channel banks, and increasing in-stream habitat for fish and macroinvertebrates.

3.5.7 Cost Estimate

The probable cost of construction for pond fill/construction of a stream channel on the property is $71,300 (Table 8).

TABLE 8. Pond fill/constructed stream channel cost estimate.

Item	Cost	Unit	Quantity	Total
Earth for backfill	$15	Cubic yard	700	$10,500
Stone	$25	Cubic yard	50	$1,250
Fabric, seed and assoc. supplies	$3,500	N/A	N/A	$3,500
Construction of channel	$125	Foot	230	$28,750
Mobilization and demobilization	$2,000	Lump sum	-	$2,000
Services during construction	10%	Construction costs	$46,000	$4,600
Engineering	15%	Construction costs	$46,000	$6,900
Contingency	20%	Construction costs	$6,000	$13,800
Total				**$71,300**

3.6 HABITAT IMPROVEMENT FROM EDISON LAKES PARKWAY TO FIR ROAD

3.6.1 Site Description and Alternatives

Approximately 4,700 feet of Juday Creek flows west between Edison Lakes Parkway and Fir Road in stream Reach 2 (Figure 1). The majority of this reach flows through residential or agricultural land. The field survey of Juday Creek (Appendix B) revealed that, in general, the stream is wide, channelized, and shallow and contains sand or silt substrates. Additionally, bank erosion was noted throughout the project reach with severe erosion occurring just west of Fir Road. Most of the problems encountered result from the modification of the original stream channel. Benefits of Best Management Practices include reduced sediment loads and potential habitat for fish and macroinvertebrates.

The alternatives considered for improving water quality in this reach include:

1. Protect the banks within the current stream boundaries using glacial stone and woody debris structures.
2. Protect the banks using fiber logs and native vegetation.
3. Reconstruction of the entire reach.
4. No action.

Alternative 1 is feasible. All the work would occur within the existing channel alignment, and the cost would be relatively low compared to other methodologies. Alternative 2 is not considered feasible. The heavy over-story limits light penetration vital to the growth of potential vegetation. Alternative 3 is not feasible because the height of the banks and the cost of excavation would be high relative to the benefits gained. Alternative 4 is feasible; however, the

water quality impacts from erosion would not decrease and the habitat would not improve without human intervention. After consideration, Alternative 1 was pursued.

3.6.2 Preliminary Design

Meandering the stream within its current boundaries using glacial stone and woody debris structures such as deflector logs, cover logs, and channel constrictors will stabilize the banks while narrowing the existing stream channel. Narrowing the channel will increase sinuosity and flow velocity, keeping fine sediments moving through the stream and exposing the natural gravel bottom. In-stream woody debris structures will also provide excellent habitat for fish and macroinvertebrates. Glacial stone will be installed on the stream banks to reduce erosion and hold woody debris structures in place. Figures 13 and 14 depict plan views of stream meandering/constriction using glacial stone and in-stream woody debris. Due to the project's length and numerous channel modifications, additional detailed plan drawings with precise calculations will be required before the project can proceed.

3.6.3 Permit Requirements

This project will require the approval of the IDNR, IDEM, CORP, and the St. Joseph County Drainage Board. Due to the magnitude of the project, permit evaluations will likely require a detailed plan with precise calculations. See Appendix D, subsections 1 and 2 for state and federal agency's comments regarding the project.

3.6.4 Landowner Agreements

There are 33 landowners that will be affected by this project. Each landowner was sent a letter discussing the project and seeking their support. Several letters have been returned (Appendix D, subsection 3E). All returned letters express interest and approval of the proposed project.

3.6.5 Social Costs

The proposed alternative for this reach has several unusual social costs associated with the construction process and the end result. Each landowner who agrees to this project needs to consider whether the change in his or her view of the stream is positive or negative. Fishing opportunities may increase following construction. This may be considered a positive or negative to each owner. Some trees will be removed as part of the construction process. There will be temporary noise and increased traffic during the one to two months of construction that must be considered. Construction access is through agricultural fields where possible; however, additional access is gained through maintained lawns. During the construction period, storage of construction materials including rock, earth, logs, and fabrics will affect a few owners. Existing septic systems in lawns will be marked and avoided during the design phase as well as the construction phase. A survey of these areas prior to design will help avoid future problems.

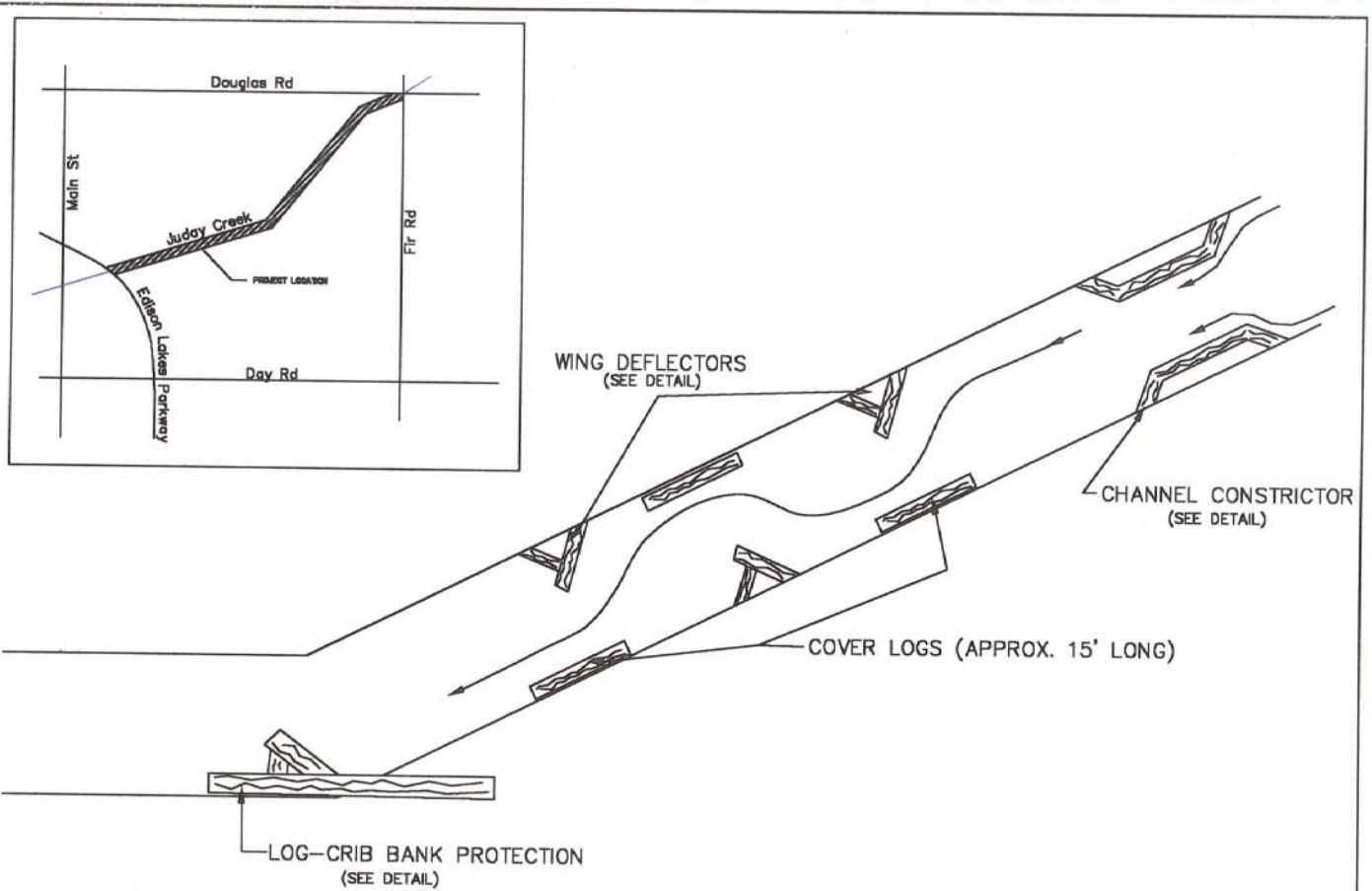
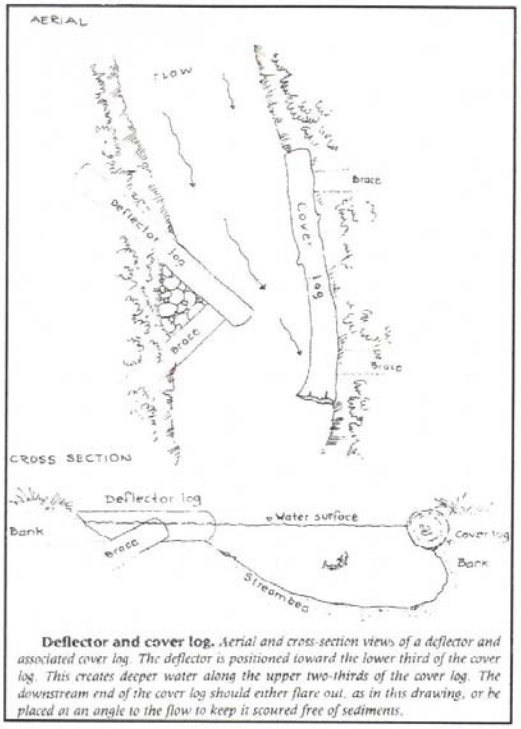


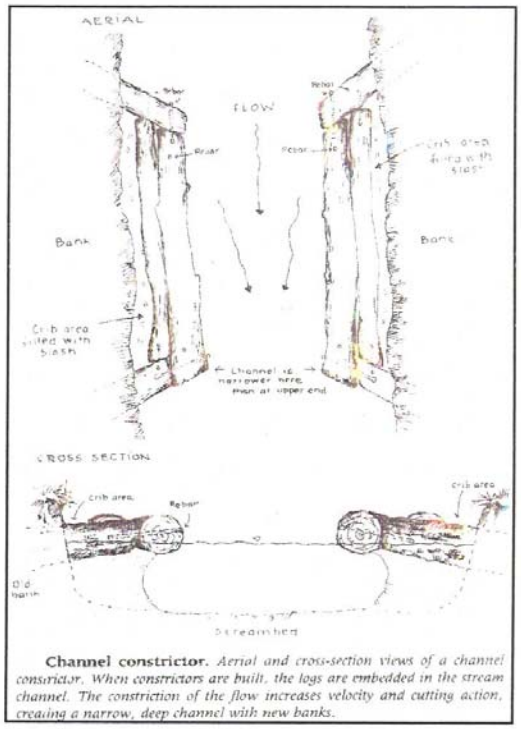
FIGURE 13: Plan View--Habitat Improvements
Juday Creek Feasibility Study
PROJECT: Habitat Improvement from Edison Lakes Parkway to Fir Rd.
St. Joseph County, Indiana

F. New & Associates, Inc.

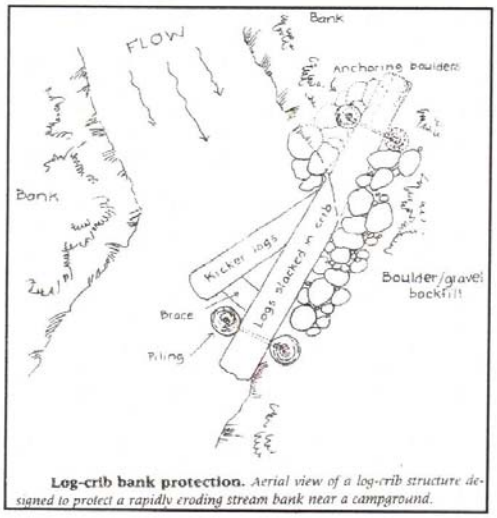
DRAWN BY: BRM
DESIGNED BY: JR
CHECKED BY:
DATE: February 27, 2002
JOB NO. 00-01-12
SCALE: NONE



Deflector and cover log. *Aerial and cross-section views of a deflector and associated cover log. The deflector is positioned toward the lower third of the cover log. This creates deeper water along the upper two-thirds of the cover log. The downstream end of the cover log should either flare out, as in this drawing, or be placed at an angle to the flow to keep it scoured free of sediments.*



Channel constrictor. *Aerial and cross-section views of a channel constrictor. When constrictors are built, the logs are embedded in the stream channel. The constriction of the flow increases velocity and cutting action, creating a narrow, deep channel with new banks.*



Log-crib bank protection. *Aerial view of a log-crib structure designed to protect a rapidly eroding stream bank near a campground.*

Figure 14: Typical In-stream Habitat Structures
Juday Creek Feasibility Study
PROJECT: Habitat Improvement from Edison Lakes Parkway to Fir Road
St. Joseph County, Indiana

JFNA#00-01-12

*Source: Better Trout Habitat; A Guide To Stream Restoration and Management (Hunter, 1991)

J.F. New & Associates
wetland consultants / environmental engineers

3.6.6 Environmental Assessment

Much of the proposed project lies within agricultural or residential land. Biological studies have been conducted in similar reaches throughout Juday Creek. Studies by Lamberti and Berg (1995) and New (Appendix E) indicate that no ETR species are present in similar reaches upstream and downstream from the project location. It is expected that during project construction, there will be minimal effects to the existing biological community. The intended goal of the project is to reduce the amount of sediment entering the stream and narrow the existing stream channel to increase velocity and expose the natural gravel bottom. Additionally, glacial stone and in-stream woody debris installation is expected to increase fish and macroinvertebrate community structure.

3.6.7 Cost Estimate

The probable cost of construction for habitat improvement between Edison Lakes Parkway and Fir Road is $146,450 (Table 9). Note: the number of structures desired can easily manipulate the cost estimate.

TABLE 9. Habitat improvement cost estimate.

Item	Cost	Unit	Quantity	Total
Clearing	$2,500	Lump sum	1	$2,500
Spawning gravel	$175	Yard (installed)	100	$17,500
Woody debris	$600	Per installation	100	$60,000
Excavation	$200	Per installation	100	$20,000
Mobilization/demobilization	$1,500	Lump sum	1	$1,000
Services during construction	10%	Construction costs	101,000	$10,100
Engineering	15%	Construction costs	101,000	$15,150
Contingency	20%	Construction costs	101,000	$20,200
Total				**$146,450**

3.7 30-FOOT FILTER STRIPS FROM CAPITOL AVENUE TO INTERSTATE 80/90

3.7.1 Site Description and Alternatives

The field survey of Juday Creek (Appendix B) revealed that stream Reach 1 consists almost entirely of straight agricultural drainages that are surrounded by row crops. Additionally, little overhead cover or streamside buffer exists throughout the reach. Approximately 4,000 feet of Juday Creek and Scamhorn Ditch (a tributary to Juday Creek) lie between Capitol Avenue and Interstate 80/90 (Figure 1). Like most of the reach, this stretch is channelized through agricultural land with banks averaging six feet high. Installation of 30-foot wide filter strips on either side of both Juday Creek and Scamhorn Ditch will improve water quality by reducing sediment and nutrient loads from entering the stream. Due to the owner(s) desire to continue farming the land, no other alternatives were considered feasible including complete stream reconstruction.

3.7.2 Preliminary Design
A 30-foot filter strip on either side of both Juday Creek and Scamhorn Ditch will total approximately 38 acres (Figure 15). Benefits of filter strips in this reach include reduced sediment and other pollutants (nutrients, pesticides, herbicides) and potential increases in habitat for fish and macroinvertebrates. The design of this filter is limited to recommended grasses specified by the Natural Resource Conservation Service (NRCS).

3.7.3 Permit Requirements
There are no permit requirements for this work.

3.7.4 Landowner Agreements
The only way to implement filter strips is to gain the permission of the landowner(s) or have the landowner(s) enroll in the NRCS's Conservation Reserve Program (CRP) on their own. Four landowners were contacted along the subject reach, first with a letter and then in person to introduce the idea of filter strips. The landowners were provided with information obtained from the NRCS on the amount of money per acre that they would receive from implementing filter strips. The landowners were then encouraged to work with NRCS if they were interested. The individual who owns the greatest land area did initiate the enrollment of their acreage into the filter strip program.

3.7.5 Social Costs
The lost farming acreage and the potential for anglers trespassing on the created filter strips are the only unusual social costs of enrolling land in the filter strip program.

3.7.6 Environmental Assessment
J.F. New & Associates did not survey the fish, macroinvertebrate, and plants communities throughout the entire proposed filter strip area due to the limited amount of water in the upper portion of the stream reach. However, Runde (1994) sampled these communities at Juday Creek's intersection with Bittersweet Road, and J.F. New & Associates sampled the biotic community downstream of the proposed project site, just east of Capitol Avenue (Appendix E). These studies found no ETR species that might be affected by work in the reach. It is expected that the filter strip project will positively benefit fish, macroinvertebrates, wildlife, and plants by reducing the sediment and nutrient loads to the creek, providing more permanent cover on the slopes, and reintroducing native plant species to the area.

3.7.7 Cost Estimate
The probable cost of construction for implementation of 30-foot filter strips between Capitol Avenue and Interstate 80/90 is $21,120 (Table 10).

TABLE 10. Filter strip cost estimate.

Item	Cost	Unit	Quantity	Total
Seeding	$500	Acre	38.4	$19,200
Annual maintenance	$50	Acre	38.4	$1,920
Total				**$21,120**

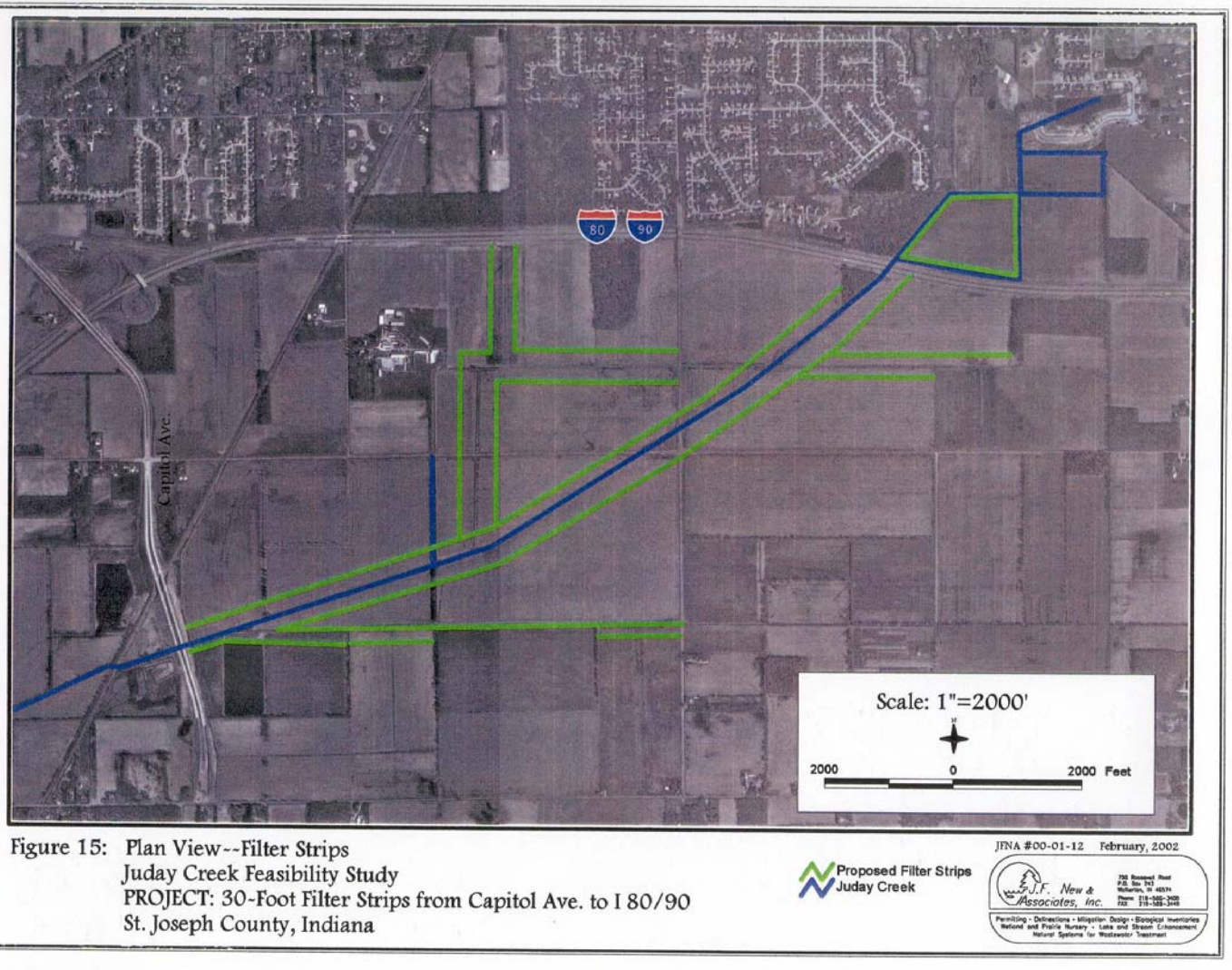


Figure 15: Plan View--Filter Strips
Juday Creek Feasibility Study
PROJECT: 30-Foot Filter Strips from Capitol Ave. to I 80/90
St. Joseph County, Indiana

JFNA #00-01-12 February, 2002

3.8 INFILTRATION TRENCH ON SOUTH SIDE OF INTERSTATE 80/90

3.8.1 Site Description and Alternatives

A 500-foot swale collects stormwater runoff from the Toll Road and channels it to Juday Creek. The swale parallels the south side of the Toll Road in Granger, Indiana, east of Juday Creek (Figure 1). The swale is currently barren of vegetation in places or dominated by shallow rooted fescue that is mowed throughout the growing season. Because the grass is sparse and mowed, the swale does little to slow or filter any stromwater runoff from the Toll Road.

The alternatives considered included:

1. Wetland swale renovation.
2. Infiltration trench using septic stone.
3. No action.

Alternative 1 would provide the most treatment for stormwater; however, a wetland swale is not compatible with the current maintenance regime. Alternative 2 allows the stormwater to be treated, is compatible with mowing, is inexpensive to install, and requires little maintenance. Alternative 3 is feasible but would not improve water quality in the stream. Based on these considerations, Alternative 2 is the best option to treat the described problem.

3.8.2 Preliminary Design

The proposed project involves the excavation of approximately 110 cubic yards of soil (two feet deep and three feet wide) from the entire existing roadside swale. Specifically, excavation will occur between the stormwater grate and Juday Creek (Figure 16). The trench will be lined with a non-woven geotextile cloth and backfilled to the original swale grade with coarse sand and gravel. The infiltration trench is designed to absorb and filter the majority of stormwater before it reaches the stream. Overflow will travel over the top of the structure as it does now. Any areas outside of the swale disturbed during construction will be seeded with a standard grass mix and covered with straw blankets.

3.8.3 Permit Requirements

The proposed project requires approval from the St. Joseph County Drainage Board and Indiana Department of Transportation (INDOT) (Toll Road District). INDOT (Toll Road District) will solicit bids for an Asphalt Paving Project in the proposed project area in June 2002. INDOT (Toll Road District) approves of the proposed project and would like to include it within their Asphalt Paving Project (Appendix D, subsection 1).

3.8.4 Landowner Agreements

The project will not affect any landowners other than the Toll Road. INDOT approves of the proposed project (See 3.8.3 above). Appendix D, subsection 1 contains a letter of communication between INDOT and New.

3.8.5 Social Costs

There are limited unusual social costs of completing the project. Traffic control will be needed near the project site. Land must also be set aside for storage of construction materials.

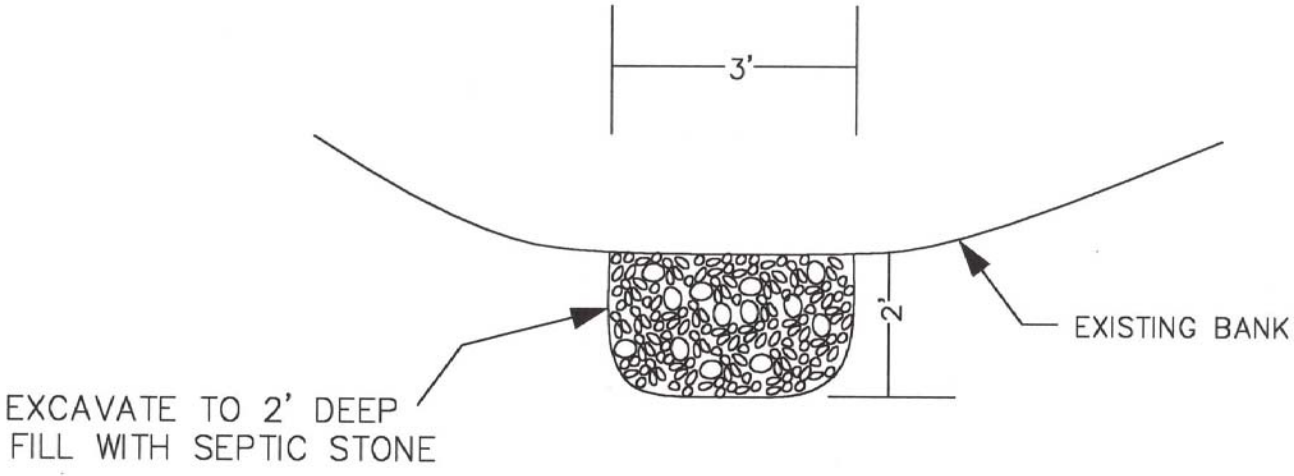


FIGURE 16: Cross Section--Gravel Infiltration Trench
Juday Creek Feasibility Study
PROJECT: Infiltration Trench on the South Side of Interstate 80/90
St. Joseph County, Indiana

J. F. New & Associates, Inc.
Permitting · Deliverations · Mitigation Design · Wetland
Nursery · Natural Systems for Wastewater Treatment Engineering

DRAWN BY:	BRM
DESIGNED BY:	JR
CHECKED BY:	
DATE: February 27, 2002	
JOB NO:	00-01-12
SCALE:	NONE

3.8.6 Environmental Assessment

J.F. New & Associates inventoried the plants along the existing slope. The plant community consists almost entirely of reed canary grass and fescue. Runde (1994) monitored fish and macroinvertebrates just downstream at Juday Creek's intersection with Bittersweet Road. The study found no ETR species that might be affected by work upstream. In fact, the project is expected to positively benefit fish, macroinvertebrates, and plants by reducing the sediment supply to the creek.

3.8.7 Cost Estimate

The probable cost of construction for the infiltration trench is $9,570 (Table 11).

TABLE 11. Infiltration trench cost estimate.

Item	Cost	Unit	Quantity	Total
Excavation/grading/hauling	$12.50	Cubic yard	110	$1,375
Gravel/sand	$25	Cubic yard	110	$2,750
Seeding	$250	Lump sum	1	$250
Straw blanket	$0.50	Square foot (installed)	3,000	$600
Mobilization/demobilization	$500	Lump sum	1	$500
Traffic control	$2,500	Lump sum	1	$2,500
Contingency	20%	Construction cost	$7,975	$1,595
Total				**$9,570**

3.9 REGRADED SLOPE/BANK STABILIZATION OF DITCH NORTH OF INTERSTATE 80/90

3.9.1 Site Description and Alternatives

A 1,000-foot drainage ditch parallels the north side of Interstate 80/90 in Granger, Indiana, just east of Juday Creek (Figure 1). This ditch has steep slopes (1:1) and is severely eroding due to the sandy soils and limited vegetation. Runoff from the Toll Road and periodic high flows in the ditch has caused most of the observed erosion. Regrading and stabilizing ditch slopes are the primary components of this proposed project.

The alternatives considered for fixing this site include:

1. Riprapping the existing slope.
2. Regrading the banks to form a 3:1 slope and vegetating with prairie grasses
3. No action.

Alternative 1 is not feasible due to the cost, negative effects to the environment, and potential hazards to mowing crews. Alternative 2 is feasible. The regrading of the slope would not only give the ditch more capacity, but would also offer the best chance for grasses to become permanently established on the slopes. Additionally, it would be safer for motorists and mowing crews. Under Alternative 3, the ditch banks would continue to erode. Based on these considerations, Alternative 2 would be the best option.

3.9.2 Preliminary Design

Design Alternative 2 proposes to utilize 25 feet of the existing 50-foot (average) top-of-bank right-of-way space along the north side of the Toll Road (Figure 17). Approximately 5,300 cubic yards of sand will be excavated in order to create a 3:1 slope. The specified seeding (Table 12) will be broadcast directly onto the surface of the soil. Straw/coconut erosion control blankets will be placed over the seed per manufacturer's recommendations. The blankets generally last one to two years before biodegrading. After that point, the specified vegetation should be adequate to protect the slope.

TABLE 12. Grass mix for slope stabilization

Botanical Name	Common Name	Quantity
Permanent Grasses:		
Andropogon gerardii	Big blue stem	16oz
Andropogon scoparius	Little blue stem	40oz
Bouteloua curtipendula	Side-oats grama	3oz
Elymus canadensis	Canada wild rye	1oz
Panicum virgatum	Prairie switchgrass	12oz
Sorghastrum nutans	Indian grass	24oz
Temporary Grasses:		
Agrostis alba	Redtop	10lbs
Avena sativa	Seed oats	25lbs
Festuca rubra (Dawson's)	Dawson's creeping red fescue	10lbs
Lolium multiflorum	Annual rye	25lbs
Phleum pretense	Timothy grass	10lbs

3.9.3 Permit Requirements

The proposed project requires approval from the St. Joseph County Drainage Board and INDOT (Toll Road District). INDOT will solicit bids for an Asphalt Paving Project in the proposed project area in June 2002. INDOT approves of the proposed project and would like to include it within their Asphalt Paving Project (Appendix D, subsection 1).

3.9.4 Landowner Agreements

The project will not affect any landowners other than the Toll Road. INDOT approves of the proposed project (See 3.9.3 above). Appendix D, subsection 1 contains a letter of communication between INDOT and New.

3.9.5 Social Costs

There are no unusual social costs of completing the project.

3.9.6 Environmental Assessment

J.F. New & Associates inventoried the plants along the existing slope. The plant community consists of reed canary grass, fescue, wild carrot, poison ivy, yarrow, and other common weedy species. Runde (1994) monitored fish and macroinvertebrates just downstream at Juday Creek's intersection with Bittersweet Road (Runde, 1994). The study found no ETR species that might be affected by work upstream. The project is expected to positively benefit fish, macroinvertebrates, and plants by reducing the sediment load to the creek, providing more permanent cover on the slopes, and reintroducing native plant species to an area that they previously inhabited.

SLOPE STABILIZATION MIX

Permanent Grasses

Botanical Name	Common Name
Andropogon gerardii	Big Blue Stem
Andropogon scoparius	Little Blue Stem
Bouteloua curtipendula	Side-Oats Grama
Elymus canadensis	Canada Wild Rye
Panicum virgatum	Prairie Switch Grass
Sorghastrum nutans	Indian Grass

Temporary Grasses

Agrostis alba	Redtop
Avena sativa	Seed Oats
Festuca rubra Dawson's	Dawson's Creeping Red Fescue
Lolium multiflorum	Annual Rye
Phleum pratense	Timothy

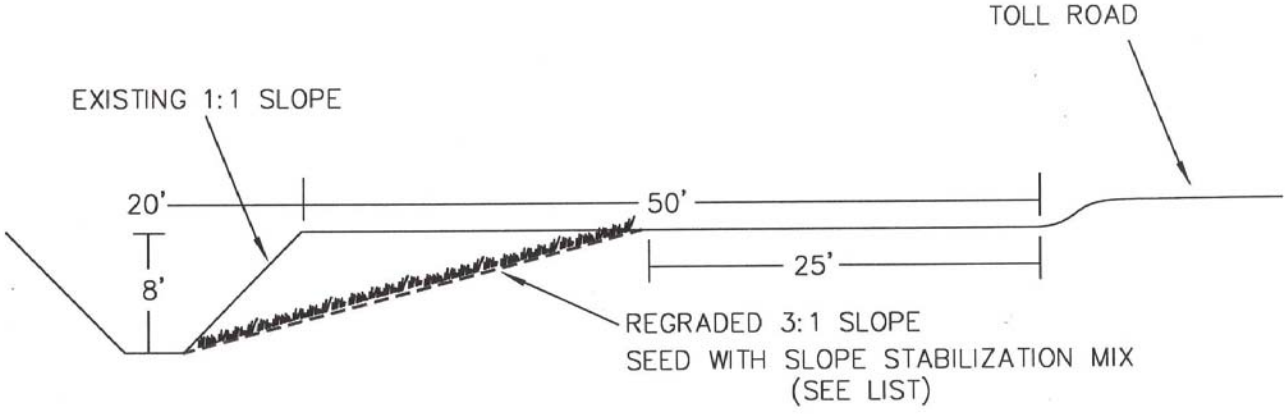


FIGURE 17: Cross Section--Slope Regrading
Judoy Creek Feasibility Study
PROJECT: Regrading Slope/Bank Stabilization of Ditch North of Interstate 80/90
St. Joseph County, Indiana

J. F. New & Associates, Inc.
Permitting · Delineations · Mitigation Design · Wetland Nursery · Natural Systems for Wastewater Treatment Engineering

DRAWN BY:	BRM
DESIGNED BY:	JR
CHECKED BY:	
DATE:	February 27, 2002
JOB NO:	00-01-12
SCALE:	NONE

3.9.7 Cost Estimate

The probable cost of construction for the regraded slope/bank stabilization is $81,300 (Table 13).

TABLE 13. Regraded slope/bank stabilization cost estimate.

Item	Cost	Unit	Quantity	Total
Excavation/hauling	$8.50	Cubic. yard	5,300	$45,050
Seeding	$2,500	Lump sum	1	$2,500
Straw blanket	$0.50	Per roll (installed)	32,400	$16,200
Traffic control	$2,500	Lump sum	1	$2,500
Mobilization/demobilization	$1,500	Lump sum	1	$1,500
Construction sub-total				**$67,750**
Contingency	20%	Construction	$67,750	$13,550
Total				**$81,300**

4.0 SUMMARY OF COST ESTIMATES, SCHEDULE, AND FUNDING

Nine proposed projects have been recommended to improve water quality and habitat within Juday Creek. Table 14 lists cost estimates for each of the recommended restoration projects outlined in previous sections of this feasibility report. Table 15 displays a schedule for designing and implementing each of the proposed projects. Table 16 lists the potential funding sources for each proposed project. Table 17 lists all potential funding sources and contact information.

TABLE 14. Summary of project budgets.

Project	Report Section	Construction	Services	Engineering	Contingency	Total
Stabilization/habitat improvement west of Brooktrails Drive	3.1	$71,150	$7,115	$10,672	$17,787	**$106,724**
Erosion control at Kenilworth Road	3.2	$750	-	-	-	**$750**
Stream reroute/wetland filter (southeast side of Interstate 80/90 at US 933)	3.3	$84,000	$8,400	$25,200	$21,000	**$138,600**
Stream reconstruction/wetland filter between Ironwood and Douglas Roads	3.4	$238,190	$23,819	$47,638	$59,547	**$369,194**
Pond fill/constructed stream channel (Douglas Road east of Ironwood)	3.5	$46,000	$4,600	$6,900	$13,800	**$71,300**
Habitat improvement from Edison Lakes Parkway to Fir Road	3.6	$101,000	$10,100	$15,150	$20,200	**$146,450**
30-foot filter strips from Capitol Avenue to Interstate 80/90	3.7	$21,120	-	-	-	**$21,120**
Infiltration trench on south side of interstate 80/90	3.8	$7,975	-	-	$1,595	**$9,570**
Regraded slope/bank stabilization of ditch north of Interstate 80/90	3.9	$67,750	-	-	$13,550	**$81,300**
Total		**$637,935**	**$54,034**	**$93,650**	**$147,479**	**$945,008**

TABLE 15. Proposed project schedules.

Project	2002				2003				2004			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4
Stabilization/habitat improvement west of Brooktrails Drive	G			D	P	C						
Erosion control at Kenilworth Road	D	C										
Stream reroute/wetland filter (southeast side of Interstate 80/90 at US 933)			G				D	P		C		
Stream reconstruction between Ironwood and Douglas Roads			G		D	P			C			
Pond fill/constructed stream channel (Douglas Road east of Ironwood)					G			D	P		C	
Habitat improvement from Edison Lakes Parkway to Fir Road		G	D	P		C						
30-foot filter strips from Capitol Avenue to Interstate 80/90	C											
Swale excavation/infiltration trench on south side of Interstate 80/90		D	C									
Regraded slope/bank stabilization of ditch north of Interstate 80/90		D	C									

G = Grant Application
D = Design
P = Permitting
C = Construction

TABLE 16. Appropriate funding sources for each project.

Project Description	319 Grant	LARE	USFWS	Other Grants	Drainage Board Match	Private Organizations or Individuals	Total
Stabilization/habitat improvement west of Brooktrails Drive		75% @ $80,043			25% @ $26,681		**$106,724**
Erosion control at Kenilworth Road					$750		**$750**
Stream reroute/wetland filter (southeast side of Interstate 80/90 at US 933)	75% @ $103,950				25% @ $34,650		**$138,600**
Stream reconstruction between Ironwood and Douglas Roads	60% @ $221,516	30% @ $110,758				10% @ $36,919	**$369,194**
Pond fill/constructed stream channel (Douglas Road east of Ironwood)		75% @ $53,475			25% @ $17,825		**$71,300**
Habitat improvement from Edison Lakes Parkway to Fir Road			75% @ $109,837		25% @ $36,612		**$146,450**
30-foot filter strips from Capitol Avenue to Interstate 80/90				NRCS $21,120			**$21,120**
Infiltration trench on south side of Interstate 80/90						IDOT $9,570	**$9,570**
Regraded slope/bank stabilization of ditch north of Interstate 80/90						IDOT $81,300	**$81,300**
Total	**$325,466**	**$244,276**	**$109,837**	**$21,120**	**$116,518**	**$127,789**	**$945,008**

TABLE 17. Potential Funding Sources and Contact Information.

Grant Name	Name	Address	City	State	Zip	Phone	Internet Address
Lilly Endowment, Inc.	N/A	P.O. Box 88068	Indianapolis	IN	46208	317-924-5471	
Golden Eagle Grant	N/A	One Monument Circle	Indianapolis	IN	46206-1595	317-261-8261	http://www.ipalco.com
Nina Mason Pulliam Charitable Trust	Harriet Ivey	135 N. Pennsylvania Suite 1200	Indianapolis	IN	46204	317-231-6075	http://www.nmpct.org
Central Indiana Community Foundation	N/A	615 N. Alabama St. Suite 119	Indianapolis	IN	46204	317-634-CICF	http://www.cicf.org/
Kosciusko County Foundation	Suzie Light	102 East Market St.	Warsaw	IN	46580	219-267-1901	http://www.kcfoudation.org
Wabash River Heritage Corridor	N/A	402 West Washington Rm. W271	Indianapolis	IN	46204-2739	317-232-4070	http://www.state.in.us/wrhcc/
NiSource Environmental Challenge	N/A	801 E. 86th St.	Merrillville	IN	46410	219-647-5246	http://www.nisouce.com/enviro/ecf.asp
Lake and River Enhancement Program	Jim Ray	402 W. Washington St.	Indianapolis	IN	46204	317-233-3870	http://www.state.in.us/dnr/soilcons/lare
Unity Foundation of LaPorte County	N/A	P.O. Box 527	Michigan City	MI	46361	219-879-0327	http://www.alco.orgs/unity
US Fish and Wildlife Service	Dan Sparks	620 S. Walker	Bloomington	IN	47403	812-334-4261	
IDEM 319 Grant	Jill Reinhart	100 N. Senate Ave.	Indianapolis	IN	4206-6015	888-233-7745	http://www.state.in.us/idem/owm

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APPENDIX A

PUBLIC MEETINGS

JUDAY CREEK FEASIBILITY STUDY
ST. JOSEPH COUNTY, INDIANA

PUBLIC MEETINGS

On May 15, 2001, J.F. New & Associates held its first public meeting at the St. Joseph County Chapter of the Izaak Walton League of America in South Bend, Indiana. The meeting was held to discuss public interest in the Juday Creek Engineering Feasibility Study. Nine individuals attended the meeting. Aerial tiles were displayed revealing the location of identified problem areas within Juday Creek and its immediate watershed. In addition, members attending the meeting revealed other potential problems and landowner information not uncovered during the initial field survey. The problem areas discussed included:

1. Buffer strips east of Capitol Avenue
2. Possible buy-up of land north of Interstate 80/90
3. Preserving nature area (Creekwood Village)
4. Dredging of delta in Juday Lake
5. Retention pond near Hepler Road

On August 14, 2001, the second public meeting was held at the Francis Branch Library in South Bend, Indiana. Ten individuals attended the meeting. Attendees were given the chance to voice their opinion regarding preliminary projects included in the Juday Creek Engineering Feasibility Study and ideas for additional projects. The following topics were discussed.

1. Flooding of property near Juday Creek's intersection with Douglas Road
2. Use of rip rap on stream banks
3. Dredging portions of Juday Creek
4. Stream reconstruction using techniques used on the Notre Dame golf course to increase fish habitat
5. Subdivision and Toll Road contamination
6. Rock walls collapsing into the stream
7. Landowners using bricks to create riffle habitats
8. Proposal for filter strips east of Capitol Avenue
9. Stream reconstruction between Ironwood and Douglas Roads

On October 16, 2001, the third and final public meeting was held at the Francis Branch Library in South Bend, Indiana. Seven individuals attended the meeting. J.F. New used a PowerPoint presentation to discussing nine proposed best management projects included in the Juday Creek Engineering Feasibility Study. All attendees were generally in favor of the proposed projects. Suggestions were made to combine stormwater outlets originating from the Hospice Center, Holiday Inn, and US 933 to a wetland filter at the southeast corner of Interstate 80/90 and US 933. Additionally, the LARE 319 Grant funds meeting was included to discuss ongoing bank stabilization work on Juday Creek.

APPENDIX B

JUDAY CREEK FIELD SURVEY

JUDAY CREEK FEASIBILITY STUDY
ST. JOSEPH COUNTY, INDIANA

JUDAY CREEK FIELD SURVEY

ST. JOSEPH COUNTY, INDIANA

April 4, 2001

Prepared For:
St. Joseph County Drainage Board

Prepared By:
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JUDAY CREEK FIELD SURVEY

Background

Juday Creek has been the focus of restoration efforts by numerous public and private agencies in the St. Joseph County region, due primarily to the declining health of its introduced brown trout population. In 1995, Cole & Associates released the Juday Creek Watershed Management Plan, which suggested that the stream be divided into seven reaches (Figure 1). A number of stream improvement projects along Juday Creek have been completed. These have been compiled into a single database (Table 1). Refer to the aerial photos in Attachment 1 for project locations.

In March 2001, J.F. New and Associates conducted a field survey to assess both existing and potential site improvements on Juday Creek. Each reach of stream was examined in detail. Stream restoration projects were evaluated as effective, marginally effective, or not effective for both water quality and habitat for fish and aquatic invertebrates. In addition, aquatic organisms and stream measurements were noted and photographs were taken of important site characteristics.

TABLE 1. Juday Creek Restoration Projects

Project #	Project Type
1	In-stream habitat improvements (Lunkers)
2	Stormwater filter
3	Street re-routing/in-stream habitat improvements
4	Retro fit storm lines, construct berms and enhance vegetation
5	Sediment trap, deep water basin
6	Redirect storm line, vegetation strip, enhancement of natural wetland
7	Sediment trap, vegetation strip
8	Redirect storm line, vegetation strip, sediment trap
9	Vegetation strip, redirection of storm water
10	Sediment trap, vegetation strip, deep detention basin
11	Retrofit storm lines, sediment trap, constructed wetland
12	Retrofit storm lines, sediment trap, constructed wetland
13	Wetland filter
14	Vegetate stream banks
15	Mitigation Wetland
16	Constructed wetland, stormwater filter
17	Lunker/log treatment
18	Stream bank improvement, in-stream habitat, stream buffer
19-55	Bank stabilization/erosion control (biologs)

Stream Reach 7 Existing Improvements

Stream Reach 7 begins at the mouth of Juday Creek where it enters the St. Joseph River on the Izaak Walton League property and extends east to US Route 933 (Figure 1 and Aerial Tiles 1 and 2). Almost the entire reach is a natural meandering stream with gravel and cobble size substrate and larger rocks up to 12 inches in diameter. Woody debris is abundant on the floodplain shelf and consists of ash, sycamore, cherry, and cottonwood. The streamside woody debris provides approximately 80% overhead cover for most of Reach 7. Both natural and artificial in-stream woody debris is also present. Most of the artificial woody debris was strategically placed for bank stabilization, erosion control, and habitat for fish and invertebrates. This woody debris is 12 to 20 inches in diameter and spaced 15-20 feet apart. In addition, an artificial sediment trap was constructed approximately 600 feet upstream from the mouth of Juday Creek (Aerial Tile 1).

Measurements of stream morphology were noted approximately 300 feet upstream from the mouth (Aerial Tile 1). Bankful width measures 40 feet wide by 4.4 feet high. The width of the stream at baseflow measures 15 feet.

Aquatic organisms were also noted in Reach 7. Species included the rainbow darter, central stoneroller, northern hog sucker, mottled sculpin, trout, Asiatic clam, isopod, chironomid species, and members of the caddisfly family.

Cross-logs and deflector logs located below the sediment trap were constructed primarily for fish and macroinvertebrate habitat and are effective (Figure 2A). They are also marginally effective for water quality. The sediment trap itself, which is designed to deposit sand and silt by slowing flow, is effective for both water quality and fish habitat downstream. The length of this trap measures 85 feet long by 25 feet wide and is four to five feet deep when dredged. It is dredged once a year.

Restoration Sites 19 and 20 (Aerial Tile 1) were installed with biologs. Their purpose is to control erosion, stabilize the bank, and provide semi-natural habitat. One biolog is lying below the water level rendering it ineffective for water quality and marginally effective for habitat. Vegetation on the biologs is lacking. Without vegetation, the biologs become ineffective. The substrate at this site consists mostly of sand and gravel.

Stream morphology measurements were noted approximately 1,700 feet upstream from the mouth. Here, the bank-full width is 19 feet wide and 4.5 feet deep. The width of the stream at baseflow is 16 feet wide. One half-inch diameter gravel is present along with in-stream woody debris every 30 feet. Overhead cover is approximately 70%.

At Restoration Sites 21, 22, 23, 24, and 25 (Aerial Tiles 1 and 2, and Figure 2B) biologs were installed to prevent erosion. Biologs at Restoration Site 21 provide temporary habitat and water quality effectiveness although very little vegetation is growing on the installations. Substrate near Restoration Site 21 consists of cobble and a narrowing of the stream channel to approximately eight feet. Biologs at Site 22 are poorly vegetated but may establish vegetation during summer months. Some biologs are effective for water quality and habitat while others are not effective for habitat quality. At Site 23, biologs were installed that are effective for water

quality and marginally effective for habitat. Biologs at Site 24 and 25 are poorly vegetated and eroding. They are not effective for water quality and marginally effective for habitat.

Bank erosion, seawalls, streamside ponds, and a poorly vegetated buffer zone typify a residential area of Juday Creek just west of Brooktrails Drive. Localized bank erosion is occurring due to poorly vegetated banks. Seawalls minimize bank erosion, but decrease aesthetic value and offer little habitat for fish and macroinvertebrates. A channel on the west side of the stream flows through a south pond and inlets into a pond to the north then back into Juday Creek. The ponds have silted in to a maximum depth of two feet. These ponds release thermal pollution to the stream and do not support high quality fish communities. A poorly vegetated buffer zone in this reach allows geese to graze and defecate near the stream.

Severe erosion is present around a stormwater outlet on the west side of Kenilworth Road (Aerial Tile 2). The erosion caused a stormwater outlet pipe to break off and collapse into the stream (Figure 2C). Two additional stormwater outlet pipes enter Juday Creek on the east side of Kenilworth Road.

Lunker structures, deflector logs, spawning gravel, and rock toe protection were installed at Site 1 to provide in-stream habitat improvements for fish and invertebrates and control erosion (Aerial Tile 2 and Figure 3A). The structures provide effective habitat but are only marginally effective for water quality. Erosion is occurring on top of the lunkers, which were backfilled with soil, seeded, and covered with erosion control material.

At Juday Creek's intersection with US Route 933, the stream is a channelized, sand-bottom run resulting from concrete banks built on the Holiday Inn property (Aerial Tile 2). The channelized area was constructed to move water through the area with minimal erosion. The concrete walls are effective for water quality by stopping erosion but do not provide effective habitat. Because the current is slower, three to four inches of silt and sand are deposited within this area. Additionally, two drains release stormwater from the Holiday Inn parking lot into Juday Creek (Aerial Tile 2). This is a potential thermal hazard that may also carry petro products into the stream.

Stream Reach 7 Needs for Additional Improvements

Reach 7 requires only minor improvements. Natural meandering, solid riparian vegetation, gravel substrate, and an abundance of habitat and water quality structures characterize most of the reach. The sand and silt deposition occurring in Reach 7 appears to be the result of activity upstream. Small improvements that might be made in Reach 7 include bank stabilization improvements on the Izaak Walton property and placement of in-stream woody debris in the upper stretches of Reach 7 near the Holiday Inn. These improvements cause scour and move fine sediments through the system while creating fish habitat. Banks just downstream from the sediment trap are undergoing moderate amounts of erosion and will benefit from bank stabalization. Bank erosion and stormwater outlet pipes currently impact several locations between Restoration Sites 22 and 1. These sites will benefit from vegetated biologs, deflectors or stormwater detention basins. Deflector logs, rock dams, and large in-stream boulders placed in the upper stretches of Reach 7 will provide more riffle-pool sequences needed for the health of trout and aquatic macroinvertebrates.

Stream Reach 6 Existing Improvements

Stream Reach 6 begins at US 933 and proceeds east to Juniper Road (Figure 1 and Aerial Tiles 2, 3, and 4). This reach is characterized as urban and residential. The stream in this reach is generally channelized, wide, and shallow. Substrate is generally gravel or sand. Woody debris is present but at much lesser quantities than in Reach 7. Overhead cover ranged anywhere from 50% to 70%.

Measurements of stream morphology were taken just east of US 933 (Aerial Tile 2). Both bankfull and baseflow measure 33 feet wide with a water depth of one foot. Wide and shallow channels are characteristics typically found in channelized streams and differs greatly from the dimensions measured in Reach 7.

Several pipes draining the parking lot behind Pickups Plus, Hospice Center, and Interstate 80/90 enter Juday Creek within a 300-foot reach (Aerial Tile 2). Again, warmwater runoff entering the stream negatively impacts aquatic organisms. Additionally, this stretch is a run with areas of bank erosion. It is wide and shallow with little in-stream cover.

At Restoration Site 2 (Aerial Tile 3), a stormwater filter has been constructed to treat runoff from Cleveland Road (Figure 3B). The ponds within the filter are generally not vegetated but do contain three to four inches of silt. Garbage is accumulating within the project site, so essentially the site is acting as a garbage control filter. However, because the stormwater filter has permanent pools, the site is a potential thermal threat to the stream.

At Restoration Sites 26, 27, 28, and 29 (Aerial Tile 3), biologs were installed to prevent erosion on sensitive banks. Besides containing little vegetation, biologs at Restoration Sites 26, 27, and 28 are temporarily effective for water quality and marginally effective for habitat. Biologs at Site 29 are completely eroded and need attention (Figure 3C). They are no longer effective for habitat or water quality. A small island also lies near this site. The entire upstream side is highly eroded. The island has little vegetation around its banks and is sensitive to erosion.

Stream Reach 6 Needs for Additional Improvements

Because of the channelized nature of stream Reach 6, several in-stream and bank stabilization installations are needed. Just east of US 933, the stream channel is wide and shallow with little in-stream habitat (Aerial Tile 2). Using woody debris such as deflectors and wing dams will help in pinching the stream to imitate natural conditions. Between Restoration Sites 27 and 29 (Aerial Tile 3), bank erosion is occurring and stabilization is needed. At Site 29 (Aerial Tile 3), where biologs are eroded and a small island is in jeopardy of being eroded away, new structures are needed. Vegetating the island and the riparian areas will be beneficial in its protection.

Stream Reach 5 Existing Improvements

Stream Reach 5 begins at Juniper Road and proceeds east to Ironwood Road (Figure 1, and Aerial Tiles 4 and 5). This reach is characterized as commercial and residential with a large portion of the stream reach intersecting the Notre Dame Golf Course. West of the golf course, the stream is similar to that of stream Reach 6. Channelization, lack of in-stream woody debris, and streamside ponds are major contributors to degradation in stream Reach 5.

Just upstream from Juniper Road lies an artificial dam acting as a sediment trap (Aerial Tile 4). Silt and sand deposition is over six inches deep above the dam. In order for this area to remain effective as a sediment trap, dredging should occur. Alternatively, the dam could be removed and the natural channel restored. However, removal of the dam could cause a headcut that might negatively impact the Kinte Road bridge.

Just upstream from the dam at Restoration Sites 30, 31, 32, and 33 (Aerial Tile 4), biologs have been installed to prevent bank erosion. Because the dam restricts flow, bank erosion is limited. The biologs are used to support lawn grasses and allow mowing to the edge of the stream. Therefore, the biologs are marginally effective for both water quality and habitat. Additionally, silt and sand deposits are over six inches deep at this site.

At Restoration Site 3 (Aerial Tile 5), Juday Creek has been re-routed, and in-stream habitat improvements were made around the Notre Dame Golf Course. Approximately 2,400 feet of Juday Creek was re-routed. Meanders, deep scour holes, woody debris, riparian vegetation, and cobble size substrate were all added to the re-routed section in hopes of returning the stream to natural conditions. Several trout were seen using this section for spawning. The site appears to be functioning normally with few signs of erosion. It is functional for both water quality and habitat. A long-term maintenance program may be needed to ensure that the restoration remains functional.

A wetland and sediment trap at Restoration Sites 4 and 5 (Aerial Tile 5) are designed to treat stormwater runoff from Ironwood Road before it enters Juday Creek. Restoration Site 5, a sediment trap, is functional for water quality and habitat downstream and prior to Notre Dame. Both sites are well vegetated, providing good riparian habitat on the banks.

Stream Reach 5 Needs for Additional Improvements

Channelization in residential areas of Reach 5 is causing the stream channel to widen and become shallow. Streamside ponds have also been constructed in this area. At a minimum, shade trees should be established on the pond borders. More woody debris and a narrower channel will benefit habitat and water quality in Reach 5.

Stream Reach 4 Existing Improvements

Stream Reach 4 begins at Ironwood Road and continues east to State Route 23 (Figure 1 and Aerial Tiles 6 and 7). This reach is largely residential and commercial. Most of the stream is channelized, wide, and shallow with a sandy substrate. Many shallow streamside ponds border the stream. Numerous projects have been constructed in this reach to control erosion and maintain bank stability. However, several stream banks are eroding or are susceptible to erosion.

A 1,200-foot, largely residential stretch of Juday Creek flows northwest between Ironwood and Douglas Roads. The field survey noted bank erosion, a sand bottom, and several streamside ponds. Unstable banks in one meander threaten one home's foundation, while streamside ponds act as sources of thermal pollutants to the stream. The erosion of both banks and the lack of habitat in the stream channel are a result of sediment deposition and poor riparian vegetation.

At Restoration Site 6 (Aerial Tile 6), redirected storm lines, a vegetation strip, and wetland filters have been constructed. These projects are effective for water quality but ineffective for habitat. Additionally, severe erosion is occurring around a stormwater drain (Figure 4A) on the north side of Douglas Road. The outlet is a concrete spillway that connects to Douglas Road at a curb cut just west of the bridge. The spillway slopes to a steel sheet pile at the waters edge. Stormwater that travels down the north side of Douglas Road causes scour around the spillway. The scour has extended to at least three feet underneath the pavement surface of Douglas Road.

Just south of Douglas Road, a natural logjam has changed the stream's morphology (Aerial Tile 6). The debris provides beneficial habitat, acts as a silt and sand trap, and does not degrade water quality. However, the logjam might become dislodged during a storm flow event. Consequently, the debris will be forced downstream.

An outlet that leads to Juday Lake is present between Douglas Road and Restoration Site 36 (Aerial Tile 6). Again, this is a major thermal impact on the stream. The retention pond is shallow, lacks tree shading, and probably becomes exceedingly warm in the summer months.

At Restoration Site 36 (Aerial Tile 6 and Figure 4A), biologs were installed. Erosion is still occurring at this site. Biologs were placed in the stream but were ineffective so additional biologs were installed for effectiveness during higher flows. Restoration Site 36 is marginally effective for both water quality and fish habitat. Just upstream from Restoration Site 36, bank erosion is occurring and is depicted in Figure 5A. At Site 7 (Aerial Tile 6), a sediment trap and vegetation strip was constructed to naturally treat stormwater runoff from State Route 23. The site appeared to be functional. Two to three inches of silt had accumulated in each sediment trap.

Stream Reach 4 Needs for Additional Improvements

Stream Reach 4 requires many of the same improvements documented for Reach 5. Streamside ponds contribute thermal pollutants to Juday Creek. Erosion along banks is extensive especially east of Restoration Site 36 (Aerial Tile 6). Shoreline protection, pond filling, and channel narrowing would benefit these areas.

Stream Reach 3 Existing Improvements

Stream Reach 3 begins at State Route 23 and continues east to Main Street (Figure 1 and Aerial Tiles 7 to 9). This reach is largely commercial and residential. The stream is channelized, wide, and shallow with a sandy substrate through most of the reach. Many small, shallow ponds border the stream through the residential areas. Several projects have been constructed within the first 1,000 feet of this reach, most to prevent stream bank erosion.

Installation of lunker structures and biologs at Restoration Sites 37 and 38 respectively (Aerial Tile 7 and Figure 3) are effective for water quality and habitat. Although Restoration Sites 37 and 38 are functional, erosion is occurring just downstream on the north side of Juday Creek. Biologs installations at Restoration Sites 39, 40, and 41 (Aerial Tile 7) are eroded and dysfunctional for water quality and habitat. Within this area, three to four-foot cut bank erosion is occurring around several ponds. This erosion is depicted in Figure 5C. Biologs and anchored natural logs at Restoration Sites 42, 43, 44, 45, 46, 47, 48, 49, 53, and 54 (Aerial Tile 7) were

installed to prevent bank erosion. However, Restoration Site 50 has one functional log and one non-functioning log. At Restoration Site 55 (Aerial Tile 8), biologs are moderately effective for water quality and habitat. A pond within this area has one to two-foot cut banks.

A pond with highly eroded banks is present between Restoration Sites 50 and 51 (Aerial Tile 7) where overhead cover is only 20-40%. Very little riparian habitat is likely the cause of the One to two-foot cut banks bordering the pond.

A six-acre pond is located south of Juday Creek Estates, just east of Restoration Sites 53 and 54 (Aerial Tile 8). The pond is a thermal threat to Juday Creek during summer months. Where Juday Creek enters the pond, obvious sediment deposition has occurred. Although the pond is a thermal threat, it does function as a sediment trap and therefore, may need to be dredged in the future. The property on the south side of the pond will eventually be developed. The owner has expressed interest in dredging the pond for fill material.

At Sites 8, 9, and 10 (Aerial Tiles 8 and 9), vegetation strips and redirected storm sewer lines, appeared to be marginally effective for water quality. A large section preceding Site 9 has erosion and very little overhead cover.

Just east of Grape Road at Restoration Site 18 (Aerial Tile 9) in a commercial area, artificial logs and wing dams were installed. They are effective for water quality and habitat. Just downstream of Main Street, at Restoration Sites 11 and 12, retro-fit storm lines, sediment traps, and constructed wetlands are both moderately effective for water quality (Aerial Tile 9).

Stream Reach 3 Needs for Additional Work

Streambank erosion is occurring between State Route 23 and Restoration Site 37 (Figure 5B). Several ponds near Restoration Site 38 have eroding banks (Figure 4C). Overhead cover is only 20% to 40% between Sites 50 and 51. This area will benefit from streamside vegetation. Juday Creek will benefit from streamside vegetation, in-stream habitat, a narrowing of the stream channel, and a possible stream redirection.

Stream Reach 2 Existing Improvements

Stream Reach 2 begins at Main Street and continues east to Fir Road (Figure 1 and Aerial Tiles 9 to 12). The reach is largely agricultural and residential. Channelization has occurring along most of the reach. In general, the stream is wide and shallow containing sand or silt bottom substrates. Riparian habitat east of Main Street is good. It consists of 70 to 90% overhead cover with wide buffer zones.

A wetland filter has been constructed at Restoration Site 13 near Juday Creek's intersection with Edison Lakes Parkway (Aerial Tile 10). It is designed to control pollutants from entering Juday Creek. An investigation of the site found it to be effective for water quality and marginally effective for habitat downstream.

Streamside vegetation and overhead cover is good from Restoration Site 13 east to Fir Road. Railroad ties, streamside gravel and rock were installed to prevent bank erosion. With exception to the railroad ties (Figure 6A), most of these structures are effective for water quality and

marginally effective for habitat. In October 2001, the railroad ties were removed (John Law, personal contact).

The substrate is mostly sand and silt before Juday Creek intersects Douglas and Fir Roads (Aerial Tile 12). Although in-stream habitat and overhead vegetation is good, severe bank erosion is occurring. Steep (1:1) banks are present from the intersection of Douglas and Fir Roads downstream approximately 1,200 feet (Figure 6B and C).

Stream Reach 2 Need for Additional Improvements

Stream Reach 2 is similar to Reaches 3, 4, and 5. Reach 2 also needs many of the same improvements. In-stream habitat improvements may not only provide better habitat and water quality since long stretches of stream consist primarily of a sand or silt substrate. Woody debris structures will narrow the existing stream channel, creating scour holes, eddies and other beneficial habitat. In-stream habitat, riprap, or glacial stone will be beneficial in Windingbrook Subdivision where bank erosion is occurring. Steep and eroding banks are present approximately 1,200 feet west of and leading up to Fir Road (Figure 6A). Resloping coupled with slope stabilization vegetation will help to control erosion. Plans are currently underway to redo the intersection of Fir and Douglas Roads. The plan will provide opportunities for water quality structures such as roadside swales and wetland filters.

Stream Reach 1 Existing Improvements

Stream Reach 1 begins at the intersection of Douglas and Fir Roads and continues northeast through Juday Creek Golf Course and agricultural land to its headwaters near Granger (Figure 1,and Aerial Tiles 12 to 20). Most of Reach 1 is channelized through agricultural land. Only a small section intersects the golf course. Little overhead cover and streamside buffers exist throughout the reach.

Stream morphology measurements were taken just upstream from the intersection of Douglas and Fir Roads (Aerial Tile 12). The stream width and bankful width are 20.5 feet with a water depth of one foot. This reach of the stream is highly entrenched. The depth of this entrenchment is 10.5 feet while the width is 35 feet (Figure 7A). These conditions are causing erosion from sloughing banks. Dogwood, cottonwood, box elder, and reed canary grass are all dominant plant species at this measurement point. The stream's substrate is a mixture of fine gravel and silt.

A small, unnamed tributary enters Juday Creek from the north on the Juday Creek Golf Course property (Figure 6B). This tributary appeared to be drainage from the many ponds on the course. Measurements of the tributary were taken. The bankful width is 13.5 feet wide. Baseflow width is seven feet. The bankful depth is approximately one foot, and the baseflow water depth is eight inches. The west bank of this tributary has no overhead cover. Its slope is approximately 1:1. The east bank has a 5:1 slope and contains only reed canary grass and a few patches of dogwood and elderberry shrubs.

Stream morphology measurements were taken just upstream from the unnamed tributary. The bankful width at this point is 16 feet with a height of 1.5 feet. Baseflow water width is 13.5 feet wide and one foot deep. A 500-foot stretch upstream from the tributary has a solid gravel

substrate and woody in-stream cover. Several trout redds were observed in this area. Although functional, the stream has only 5% to 10% overhead cover.

Large sand and dirt piles were observed adjacent to Juday Creek near the east end of the Juday Creek golf Course. Heavy rains appear to have formed an erosion gully. The gully transports sediment directly from the piles to the stream. The St. Joseph County Drainage Board has expressed interest in removing these sediment piles (John Law, personal contact).

Almost the entire watershed east of the Juday Creek Golf Course is agricultural (Figure 7C). The stream has been completely channelized in the form of ditches aimed primarily at removing water from agricultural fields. Despite the channelization, A moderately effective buffer zone lies between row crop agricultural fields and the stream. The buffer provides approximately 50% overhead cover. Stream measurements were taken just east of the Juday Creek Golf Course. The top of ditch at normal ground level measures 20 feet across while the stream itself is only six feet wide.

Just east of Capital Avenue, Scamhorn Ditch enters Juday Creek (Aerial Tiles 14 and 15 and Figure 8A). Scamhorn Ditch and Juday Creek consist entirely of silt with no overhead cover and minimal buffer zone separating them from agricultural row crop fields. Measurements were taken at Scamhorn Ditch approximately 1,000 feet upstream from its confluence with Juday Creek (Aerial Tile 15). At normal ground level, the ditch measures 29 feet across and seven feet deep. Bankful width is 16 feet and 15 inches deep. The width is 14.5 feet with a water depth of nine inches. Measurements of Juday Creek were taken approximately 1,000 feet just upstream from its junction with Scamhorn ditch (Aerial Tile 15). At normal ground level, Juday Creek measures 31 feet across and six feet deep. Bankful width was 16 feet wide and 12 inches deep. The stream itself was 15 feet wide and 6 inches deep. Little buffer or overhead cover exists from this point east to Bittersweet Road. Additionally, evidence of in-stream dumping was observed (Figure 8B).

Juday Creek turns into a series of small, channelized ditches surrounded by several agricultural fields after passing northeast under Interstate 80/90 (Aerial Tile 19). In this section, little overhead cover or buffer zones exists (Figure 8C). The stream/ditch continues north until reaching a retention pond within Anderson Lake Estates on Anderson Road in Granger.

Stream Reach 1 Need for Additional Improvements

Stream Reach 1 is largely converted into agricultural ditches. Therefore, many restoration projects could be implemented to improve the reach. First, many of the highly sloped banks could be resloped to prevent more erosion in the future. Next, stretches of stream along agricultural land could be converted into meanders with the addition of other in-stream debris. Stream reconstruction will return the stream to its original functional condition. Lastly, many riparian buffers that are too small and do not benefit water quality could be extended. At a minimum, 30-foot wide buffer strips are needed.

Conclusion

The entire length of Juday Creek from the mouth at the Izaak Walton League to the headwaters in Granger was walked in late March 2001. The condition and effectiveness of existing water quality and habitat improvement were noted during the survey. Existing improvements were of four general types. One type is general bank protection using biologs, natural woody debris, rocks, railroad ties, concrete, block, and riprap protection. A second type is stormwater treatment using detention basins and wetland or grass filters. A third type is habitat improvement by installation of gravel spawning substrate, wing deflectors, cover logs, overhanging woody debris, and the creation of riffle pool sequences in reconstructed channel reaches. The fourth type of improvement is the construction of sediment traps.

In our opinion, installation of riffle pool substrate, revegetation of the streamside buffer, and woody debris like that completed at the Notre Dame Golf Course is the most effective for improving water quality and habitat. However, the cost ($125.00 to $150.00 per foot) may be prohibitive on a large scale. Woody debris and stone bank protection is the second most effective technique to improve water quality and habitat. These methods narrow the channel and cause better scour. Better scour exposes the natural stream gravels. The cost of these treatments ranges from $35.00 to $45.00 per foot. Additional water quality improvements include retrofitting existing storm lines to flow into grassy areas or fully vegetated wetland filters. These projects can be completed for $5,000 to $40,000 per filter depending on the size of the drain. Research conducted by Notre Dame has shown that modified detention structures for parking lots have little or no negative affects. Thus, these should continue to be used as a benefit to water quality.

The primary reason for biolog failure is their inability to establish deeply rooted plants that can survive shady conditions. Mowing along the biologs also decreases their effectiveness. However, biologs placed in ideal conditions show good success. Alternatives for consideration include the installation of glacial stone, riprap, or natural logs along the banks. Mowing or shading will not affect these structures.

Sediment traps are functioning to reduce bed load immediately downstream. While it is considered a band-aid approach to addressing sediment loading, their construction and maintenance is recommended until the load is controlled. Maintenance should take place each year during late fall or early winter months.

A detailed analysis of existing stream improvements including their effectiveness on water quality and as fish or macroinvertebrate habitat are listed in Table 2 while Table 3 lists needs for additional improvements including project location and estimated cost per foot.

TABLE 2. Juday Ceek Existing Improvements

Treatment Type	Reach #	Site #	Water Quality	Habitat	Cost/Ft.	Comments
Cross logs/Deflectors	7		Marginally Effective	Effective	$30-40	
Biologs	7	19 & 20	Not Effective	Marginally Effective	$35-45	One below water level
Biologs	7	21	Effective	Effective	$35-45	Poorly vegetated
Biologs	7	22	Effective	Marginally Effective	$35-45	Poorly vegetated
Biologs	7	23	Effective	Marginally Effective	$35-45	New
RR Ties	7		Marginally Effective	Effective	$40-50	Water getting behind ties
Stone Wall	7		Not Effective	Not Effective	$80-100	Wall is collapsing
Lunker Structure	7	1	Not Effective	Effective	$50-60	Rock and soil erosion
Concrete Walls	7	Holliday Inn	Effective	Not Effective	$50-60	Caused run in stream
Storm Water Filter	6	2	Marginally Effective	NA		Possible thermal problem
Biologs	6	26, 27, & 28	Effective	Marginally Effective	$35-45	New
Biologs	6	29	Not Effective	Not Effective	$35-45	Completely eroded
Biologs	5	30, 31, 32, 33	Effective	Marginally Effective	$35-40	New
Stream redirection	5	3	Effective	Effective	$125.00	
Storm Water Detention	5	4, 5	Effective	Effective		Highly vegetated, silt deposition
Seawalls	5		Effective	Not Effective	$20sq.ft.	
Biologs	4	34	Marginally Effective	Marginally Effective	$35-45	
Biologs	4	36	Not Effective	Marginally Effective	$35-45	Lower layer below water level
Sediment Trap/Vegetation strip	4	7	Effective	NA	10/20sq.ft	2-4 inches of silt in traps
Lunker Structure	3	37	Not Effective	Effective	$50-60	
Biologs	3	38	Not Effective	Not Effective	$35-45	Eroded
Biologs	3	39, 40, & 41	Not Effective	Not Effective	$35-45	Eroded
Biologs	3	42-49	Effective	Effective	$35-40	
Biologs	3	50	1 Effective, 1 not	1 Effective, 1 not	$35-40	
Biologs	3	51-55	Effective	Effective	$35-40	
Veg. Strip/Redirection (Stormwater)	3	9	Marginally Effective	Marginally Effective	$30	
Stream Buffer	3	18	Effective	Marginally Effective	$10-15	
Wetland Filter	2	13	Marginally Effective	NA	$30	

TABLE 3. Juday Creek Need for additional improvements

Treatment Type Needed	Reach #	Site # or Location	Cost/Ft.	Comments
Bank Stabalization	7	Between Sites 22 and 1	$30-40	Moderate bank erosion
In-stream Habitat	7	Holiday Inn Property		Channelized run
Stormwater Treatment	7	Holiday Inn Parking Lot		
Stormwater Runoff filter	7	Kenilworth Road		Pipes are entering stream
Riparian Habitat	7	Human-made Ponds		Eroded and open pond banks
Narrowing of Channel	6	Just East of US 933		Shallow and wide
Stormwater Treatment	6	Between Holiday Inn and I 80/90		
In-stream Habitat	6	Just East of US 933		Channelized run
Bank Stabalization	6	Just West of Interstate 80/90	$30-40	Bank erosion
In-stream Habitat	6	Just East of Interstate 80/90		Channelized run
Stormwater Treatment	6	At Ironwood Road		
Drainage	4	Douglas Road		Possible diversion to wetland
Narrowing of Channel	4	South of Douglas		
Bank Stabalization	4	East of Site 36	$35-40	Bank erosion & poor biolog installation
Bank Stabalization	3	Just East of State Route 23	$35-40	Severe bank erosion
Riparian Habitat	3	Near Site 38		Eroded pond banks
Riparian Habitat	3	Just East of Site 50		Eroded pond banks
Riparian Habitat & Bank Stabalization	3	Just West of Site 55 to Retention Pond		No overhead cover
Riparian Habitat	3	Just West of Sites 8 & 9		No overhead cover
Narrowing of Channel	2	Site 13-Brook Trails Subdivision		Wide and shallow
Resloping	2	Brook Trails Sub. to Fir Road		
Bank Stabalization or resloping	2	Just West of Fir Road		Steep bank erosion
Bank Stabalization	2	Within Brook Trails Sub.		
Raising Stream to Grade	1	Just East of Fir Road		Deeply entrenched ditch
Resloping	1	West Bank of Trib. In Golf Course		
Bank Stabalization	1	Railroad Tracks West of Capital Road		
Stormwater Treatment	1	Outlet Between Capital Road and Railroad		
Meanders/Stream re-routing	1	Golf Course to Interstate 80/90		Wide and Channelized
Channel Reconstruction	1	Juday Creek Golf Course to Interstate 80/90		
Riparian Habitat	1	Aerial Tiles 16, 17 and 19		ineffective riparian cover
Buffer Strip	1	Aerial Tile 16		Ineffective buffer

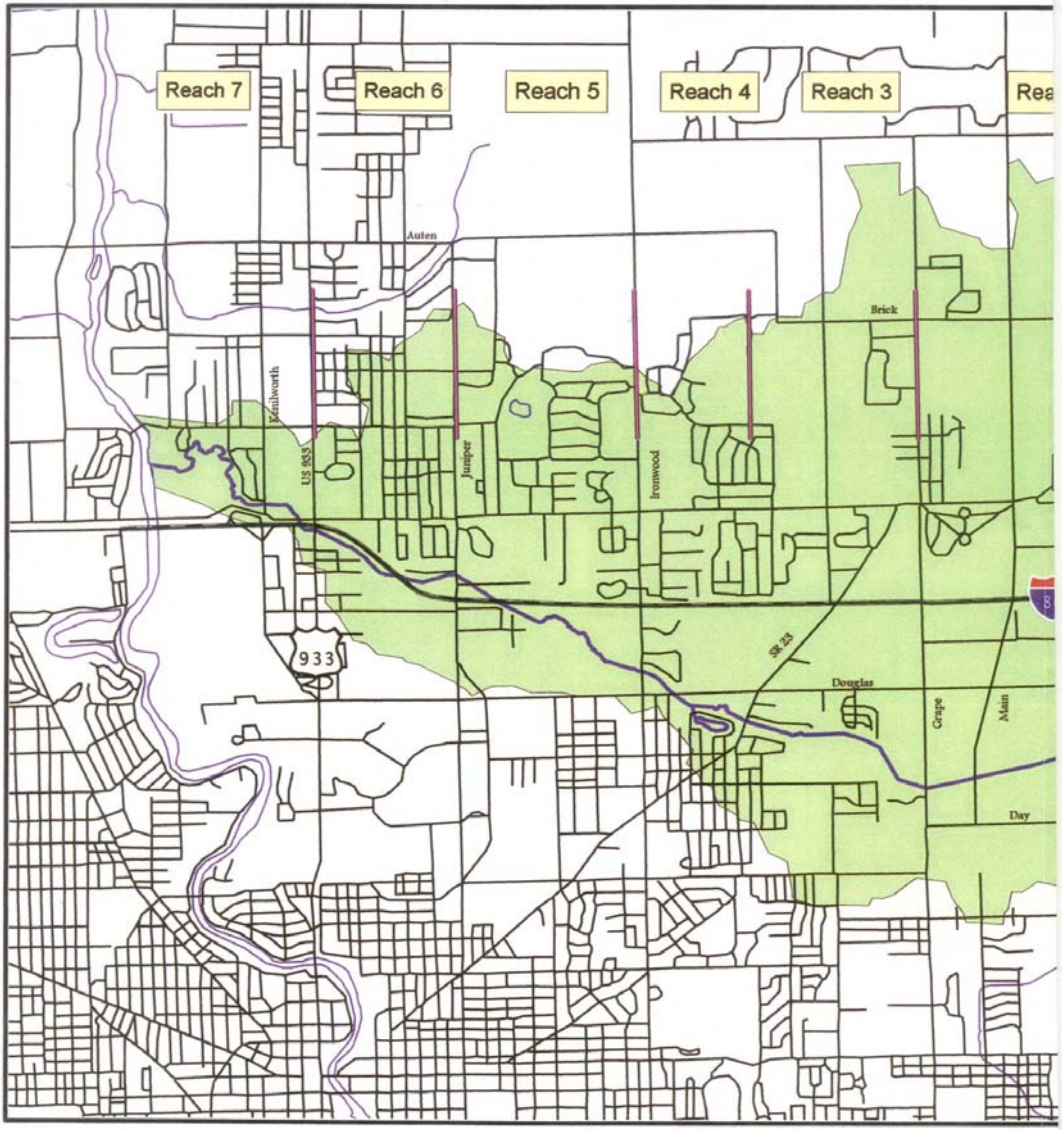
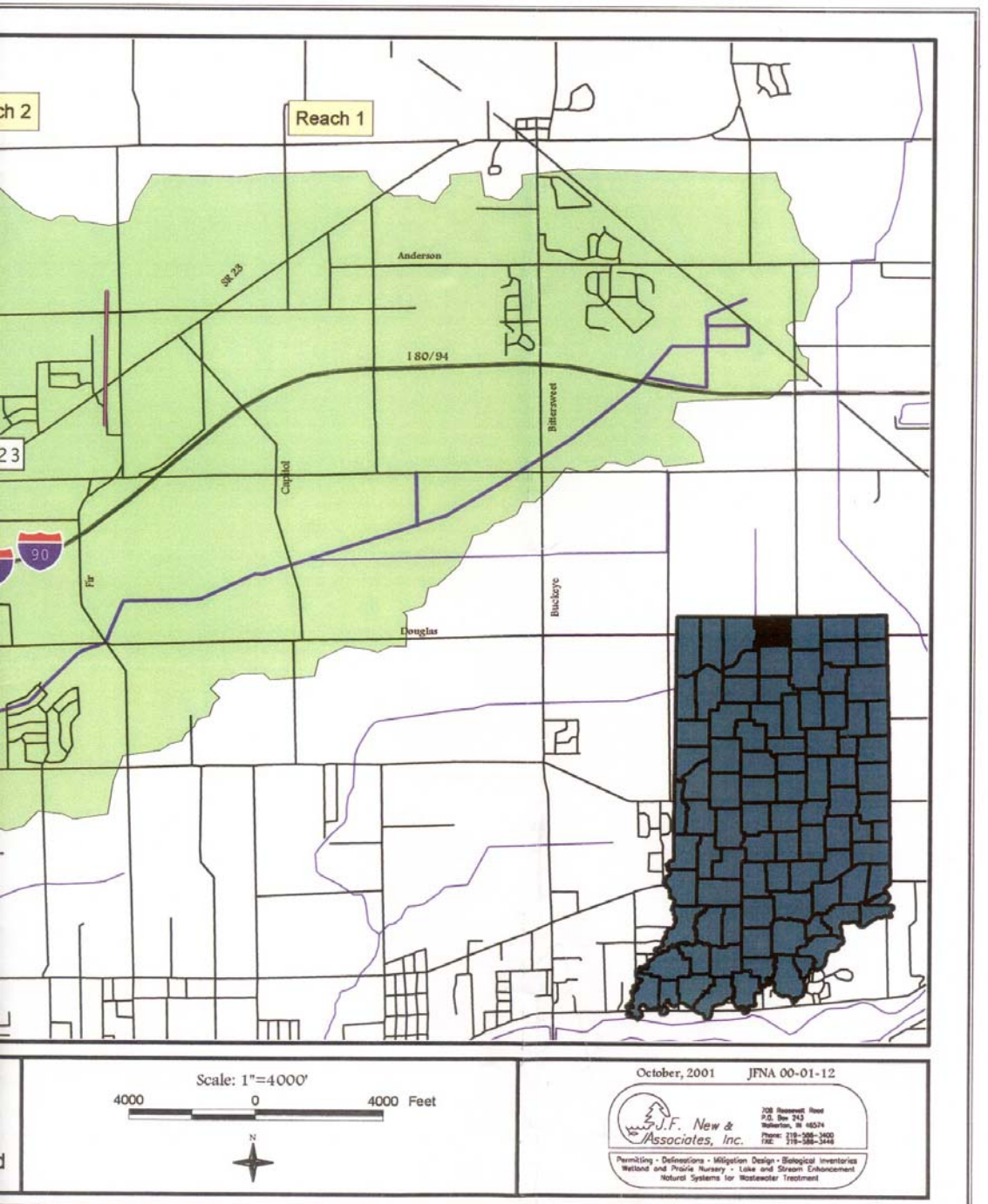


Figure 1
Juday Creek Lower Watershed
St. Joseph County, Indiana

Stream Reaches
Roads
Juday Creek
Juday Creek Lower Watershe


ch 2
Reach 1
Anderson
SR 23
I 80/94
Bittersweet
Capitol
Fir
Buckeye
Douglas
90
23
Scale: 1"=4000'
4000
0
4000 Feet
N
October, 2001
JFNA 00-01-12
J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 343
Walkerton, IN 46574
Phone: 219-586-3400
FAX: 219-586-3448
Permitting - Delineations - Mitigation Design - Biological Inventories
Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

A: Stream Reach 7, Cross Log

B: Site 21, Stream Reach 7, Biolog/Rock Installation

C: West Side of Kenilworth Road

FIGURE 2. In-stream and Bank Stabilization Installations

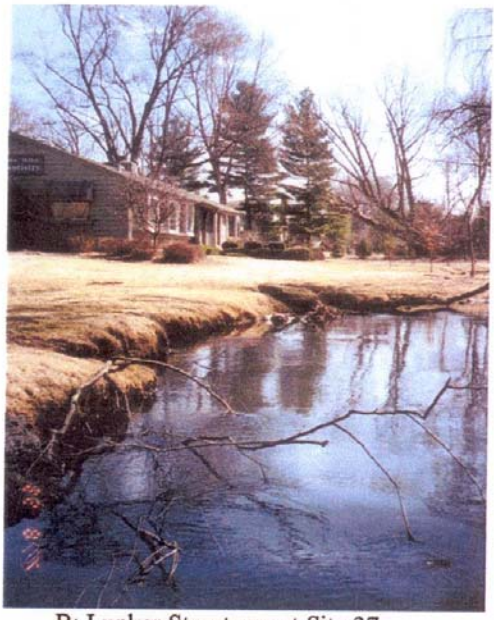
A: Site 1, Stream Reach 7, In-stream Habitat Improvements

B: Site 2, Stormwater Filter

C: Site 29, Biolog Erosion

FIGURE 3. Sites in Stream Reach 7 and 6.

A: Erosion on Douglas Road Bridge



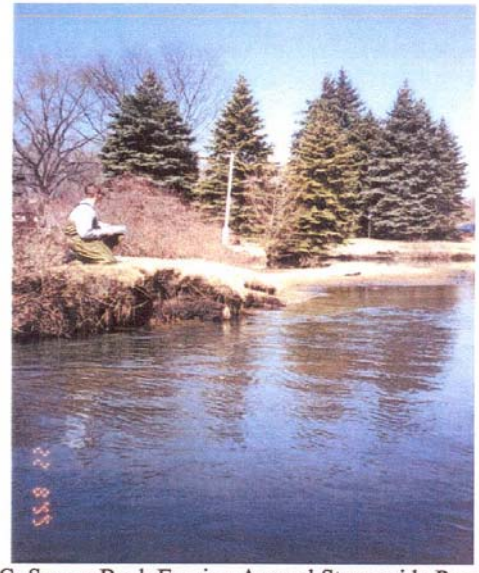
B: Lunker Structures at Site 37

C: Installation of Biologs at Site 36

FIGURE 4. Erosion and Biolog Installation in Stream Reach 4.

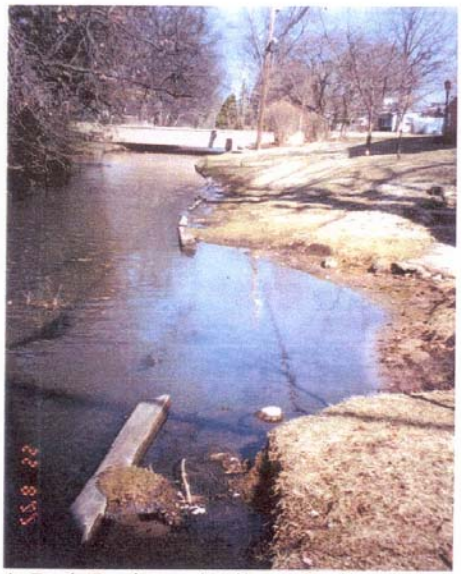
A: Eroded Biolog Installation

B: Biolog Installation



C: Severe Bank Erosion Around Streamside Pond

FIGURE 5. Erosion and Biolog Installation in Stream Reach 3 and 4.



A: Bank Erosion and Failure of Railroad Ties

B: Bank Erosion Near Fir Road

C: Erosion Near Fir Road

FIGURE 6. Erosion Throughout Stream Reach 3 and 2.

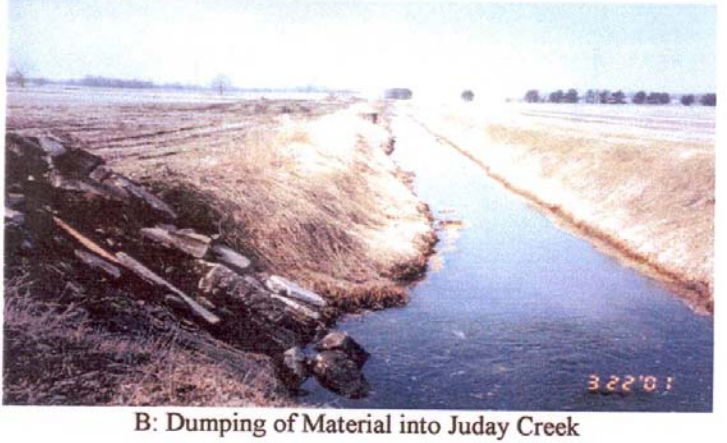
A: Steep Eroded Banks

B: Tributary at Juday Creek Golf Course

C: Channelized Nature of Stream Reach 1

FIGURE 7. Tributaries, Erosion and Channelization in Stream Reach 1

A: Scamborn Ditch Entering Juday Creek in Reach 1



B: Dumping of Material into Juday Creek

C: Ditch North of Interstate 80/90

FIGURE 8. Ditches, Dumping, and

ATTACHMENT 1

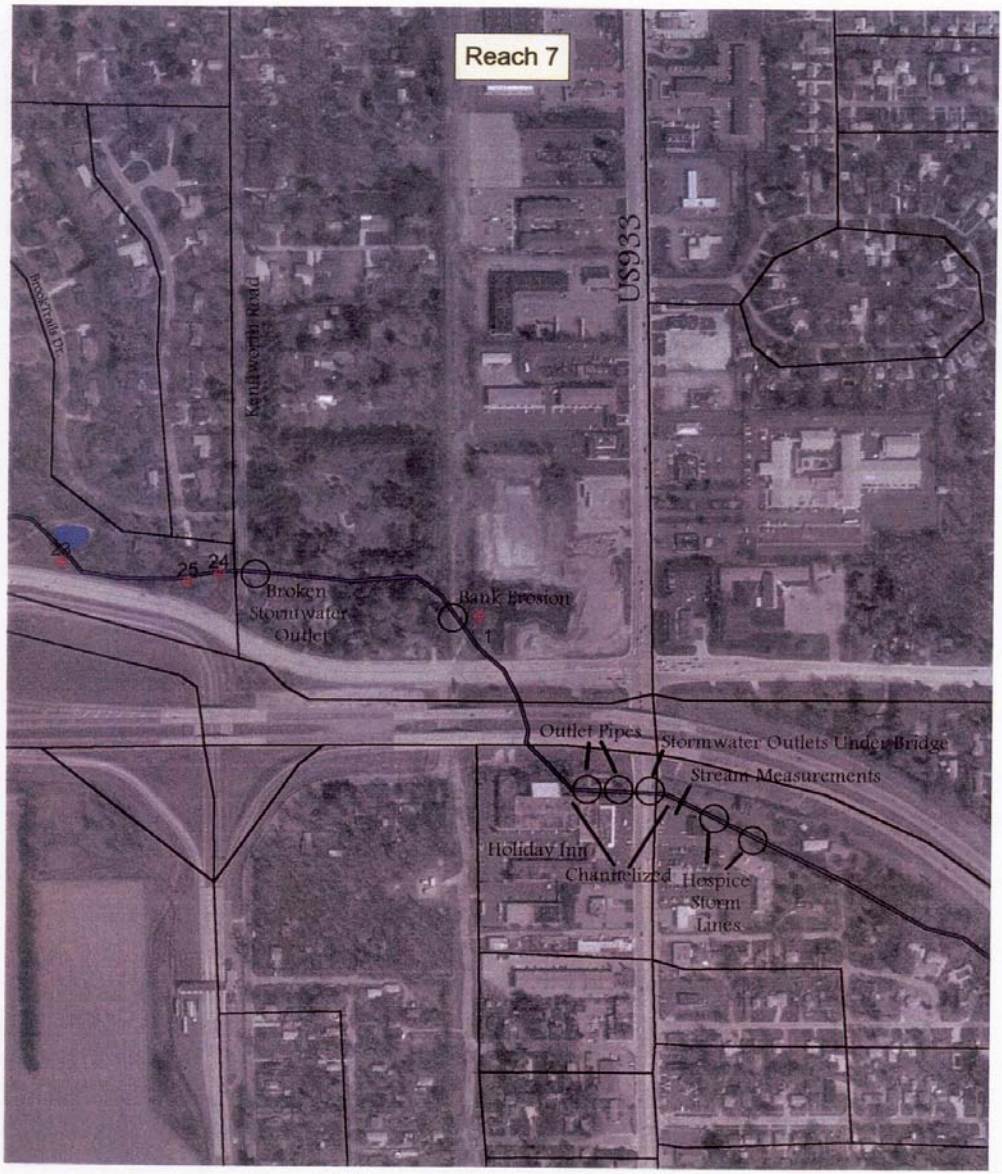
AERIAL TILES

JUDAY CREEK
ST. JOSEPH COUNTY, INDIANA

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 1

JFNA 00-01-12

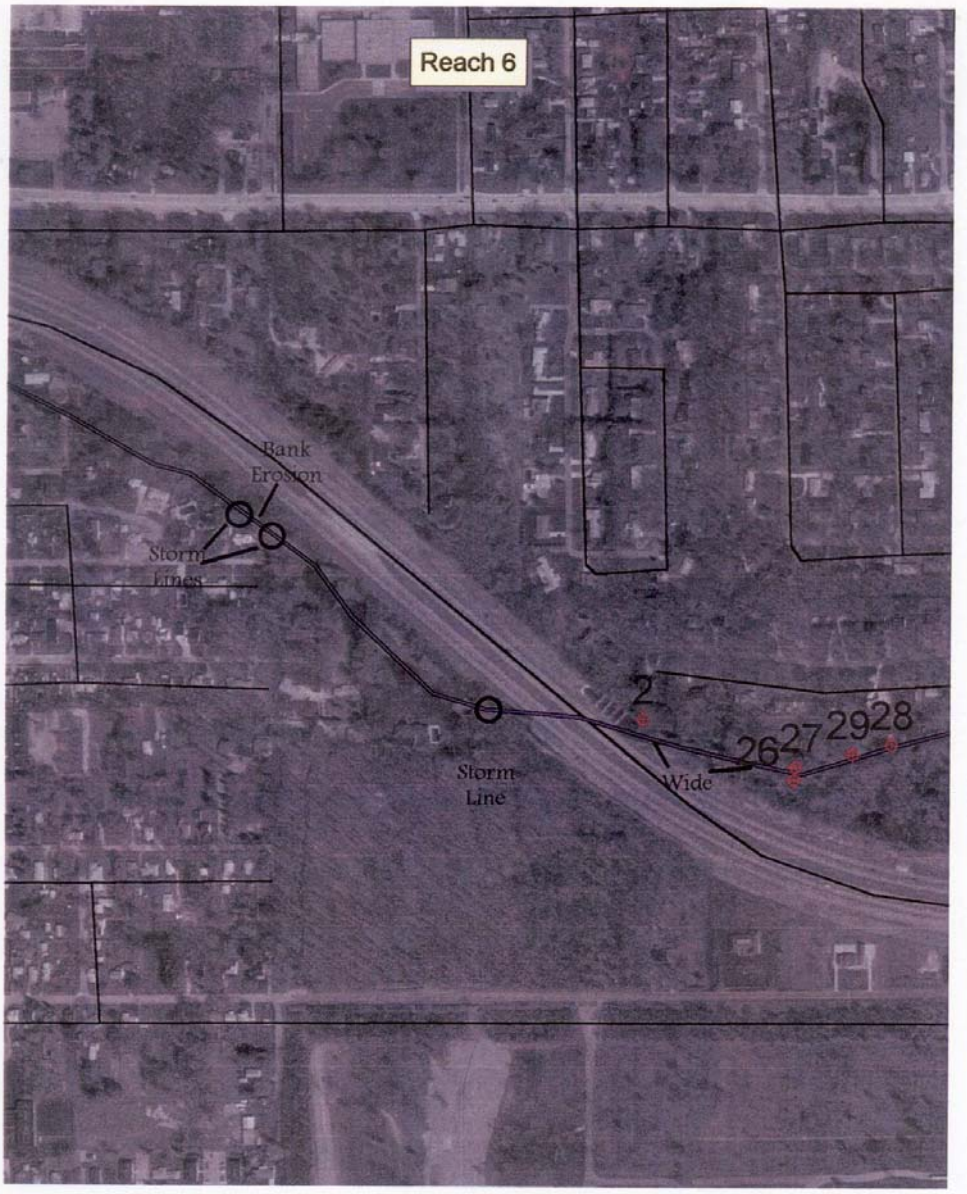
J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 743
Walkerton, IN 46574
Phone: 219-586-3400
FAX: 219-586-3446
Permitting - Delineations - Mitigation Design - Biological Inventories
Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment



Juday Creek
Engineering Feasibility Study
Field Survey
Tile 2

JFNA 00-01-12

J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 243
Walkerton, IN 46574
Phone: 219-586-3400
FAX: 219-586-3446
Permitting - Delineations - Mitigation Design - Biological Inventories
Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment



500 0 500 Feet

1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 3

JFNA 00-01-12

J.F. New & Associates, Inc.

Permitting - Delineations - Mitigation Design - Biological Inventories
Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

500 0 500 Feet

1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 4

JFNA 00-01-12

J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 242
Watertown, WI 53094
Phone: 920-261-3400
FAX: 920-261-3418
Permitting • Delineations • Mitigation Design • Biological Inventories
Wetland and Prairie Nursery • Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

500 0 500 Feet

1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 5

JFNA 00-01-12

J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 342
Walkerton, IN 46574
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FAX: 219-586-3478
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Juday Creek
Engineering Feasibility Study
Field Survey
Tile 6

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Natural Systems for Wastewater Treatment

500 0 500 Feet

1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 7

JFNA 00-01-12

J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 343
Walkerton, IN 46574
Phone: 219-586-3400
FAX: 219-586-3448
Permitting - Delineations - Mitigation Design - Biological Inventories
Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

500 0 500 Feet

1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 8

JFNA 00-01-12

J.F. New & Associates, Inc.
108 Roosevelt Road
P.O. Box 343
Pemberton, IN 46374
Phone: 219-588-3400
FAX: 219-588-3440
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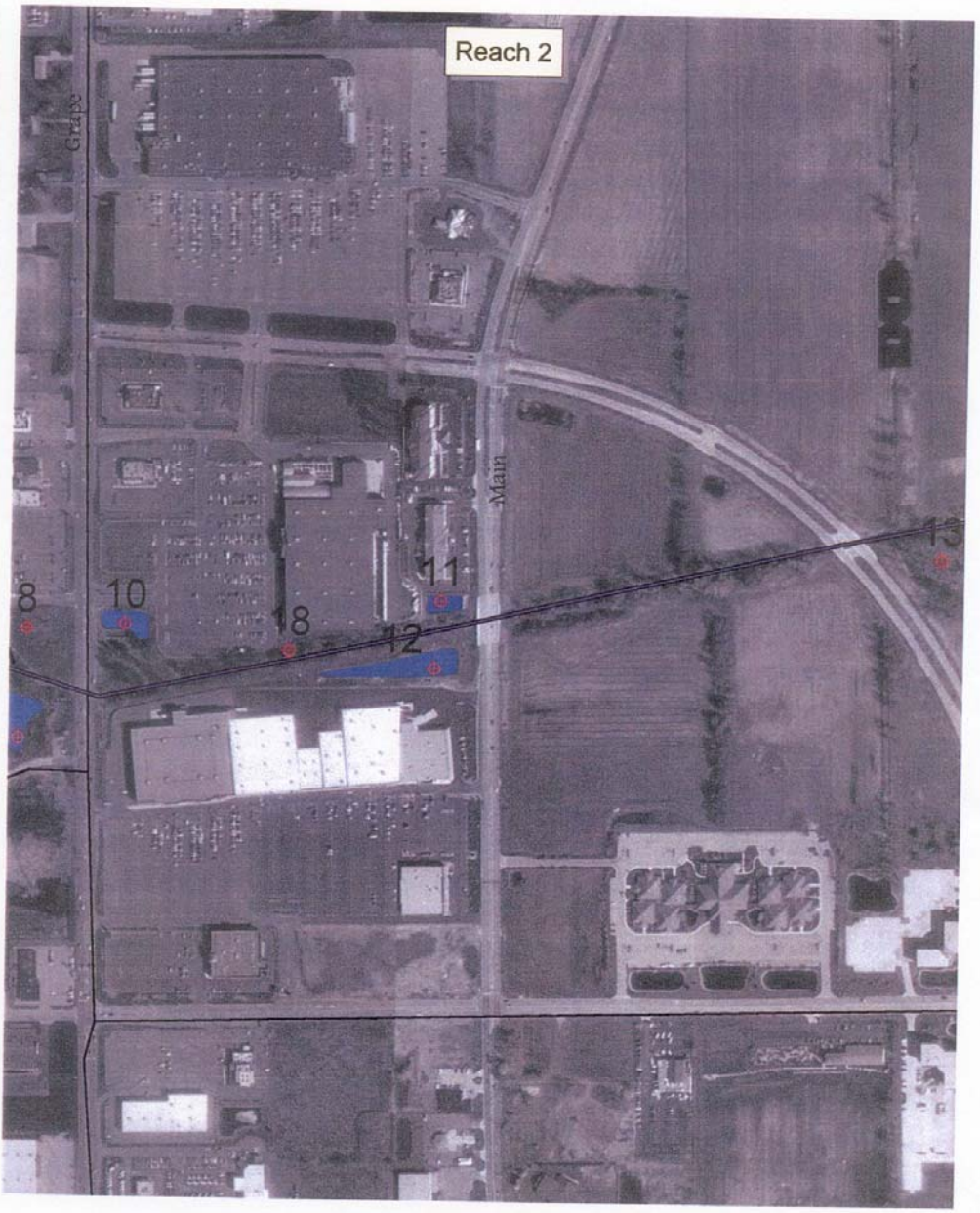
Restored and Prairie Nursery • Lake and Stream Enhancement
Natural Systems for Wastewater Treatment



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1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 9

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J.F. New & Associates, Inc.
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Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

500 0 500 Feet

1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 10

JFNA 00-01-12

J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 243
Walkerton, IN 46574
Phone: 219-586-3400
FAX: 219-586-3446
Permitting - Delineations - Mitigation Design - Biological Inventories
Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

500 0 500 Feet

1"=500'

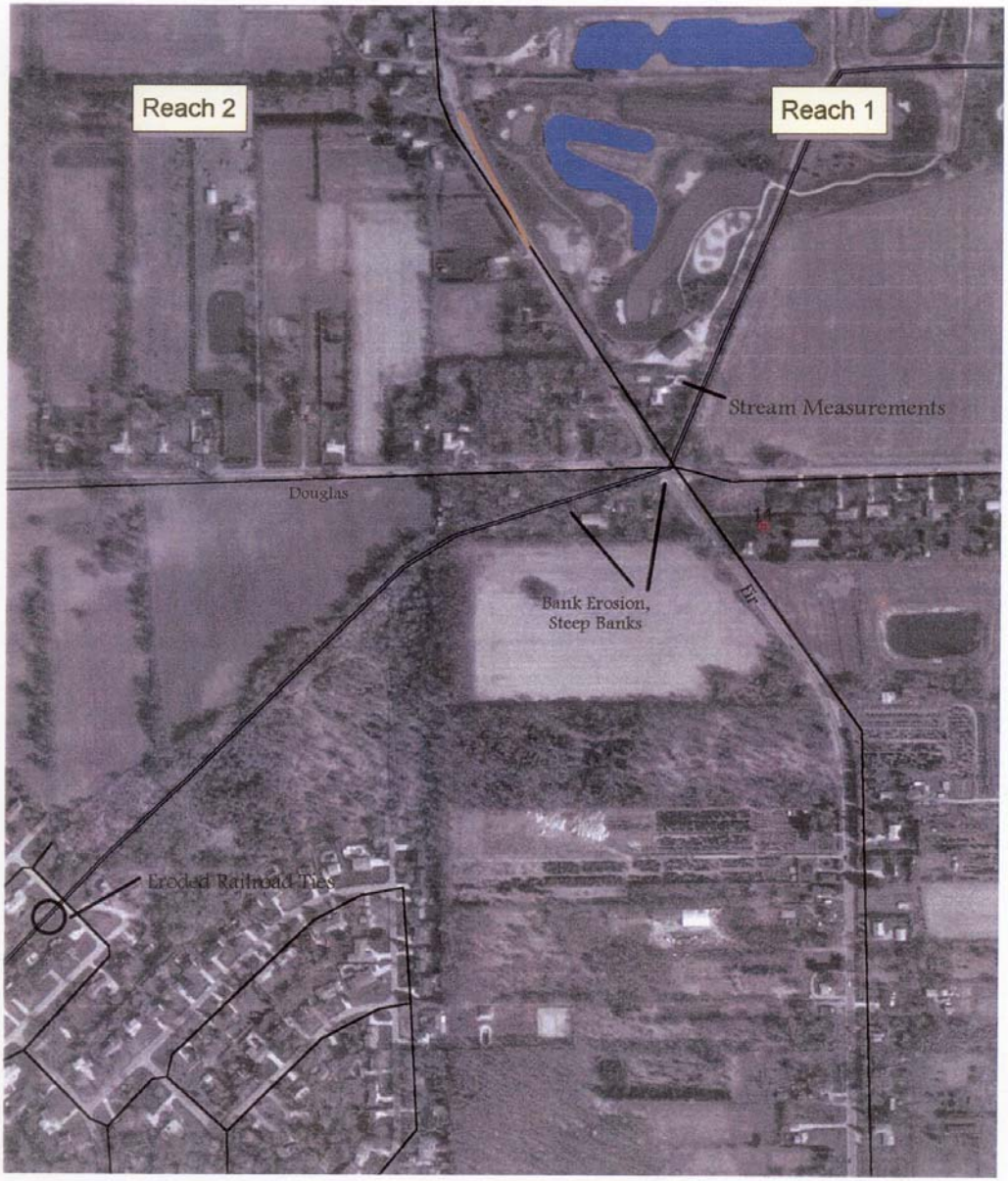
N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 11

JFNA 00-01-12

J.F. New & Associates, Inc.

Permitting - Delineations - Mitigation Design - Biological Inventories
Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment



Juday Creek
Engineering Feasibility Study
Field Survey
Tile 12

JFNA 00-01-12

J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 242
Walkerton, IN 46574
Phone: 219-586-3400
FAX: 219-586-3446
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Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 13

JFNA 00-01-12

J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 242
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Phone: 219-586-3400
FAX: 219-586-3446
Permitting - Delineations - Mitigation Design - Biological Inventories
Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

500 0 500 Feet

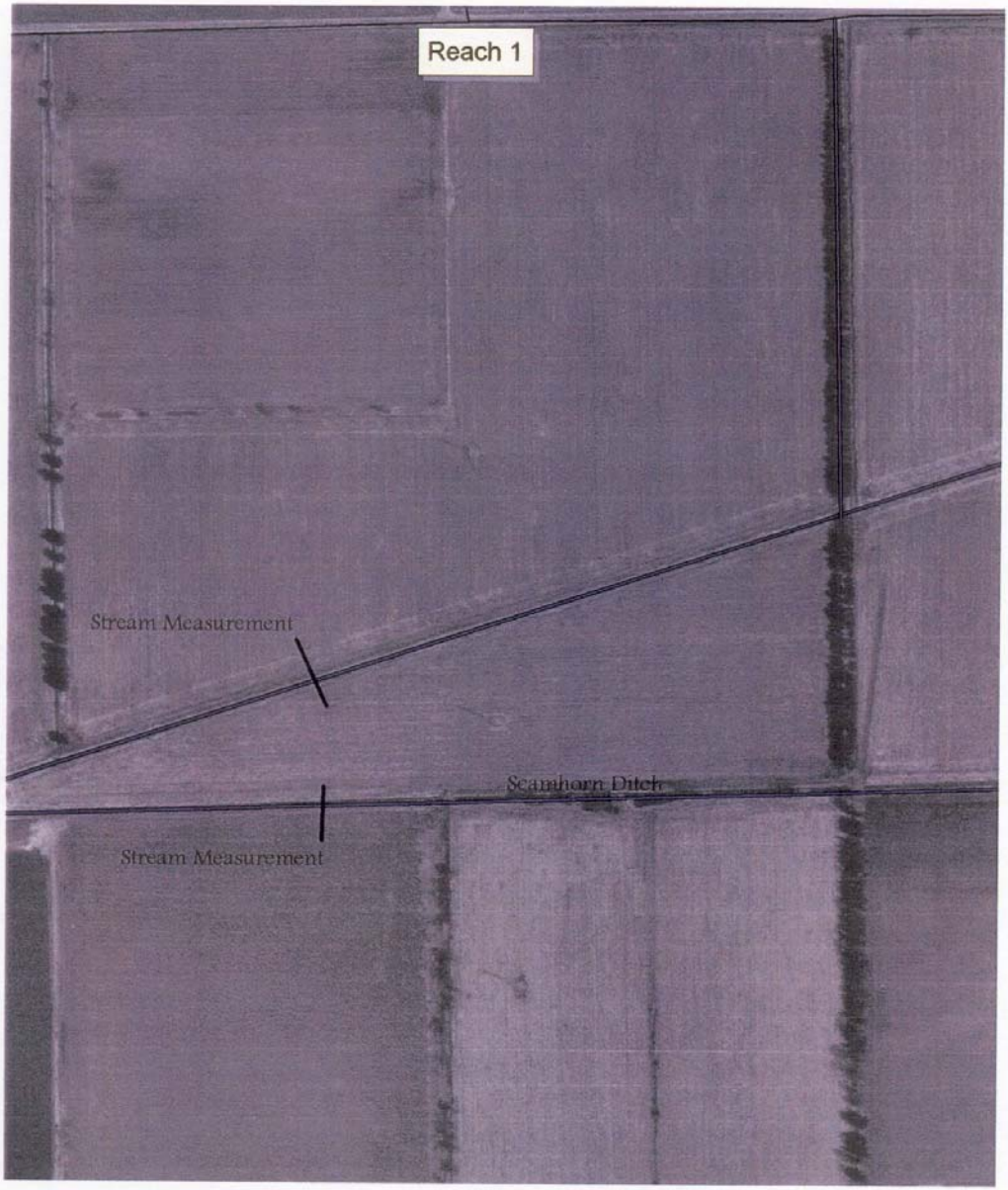
1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 14

JFNA 00-01-12

J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 242
Walkerton, IN 46574
Phone: 219-586-3400
FAX: 219-586-3445
Permitting - Delineations - Mitigation Design - Biological Inventories
Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment



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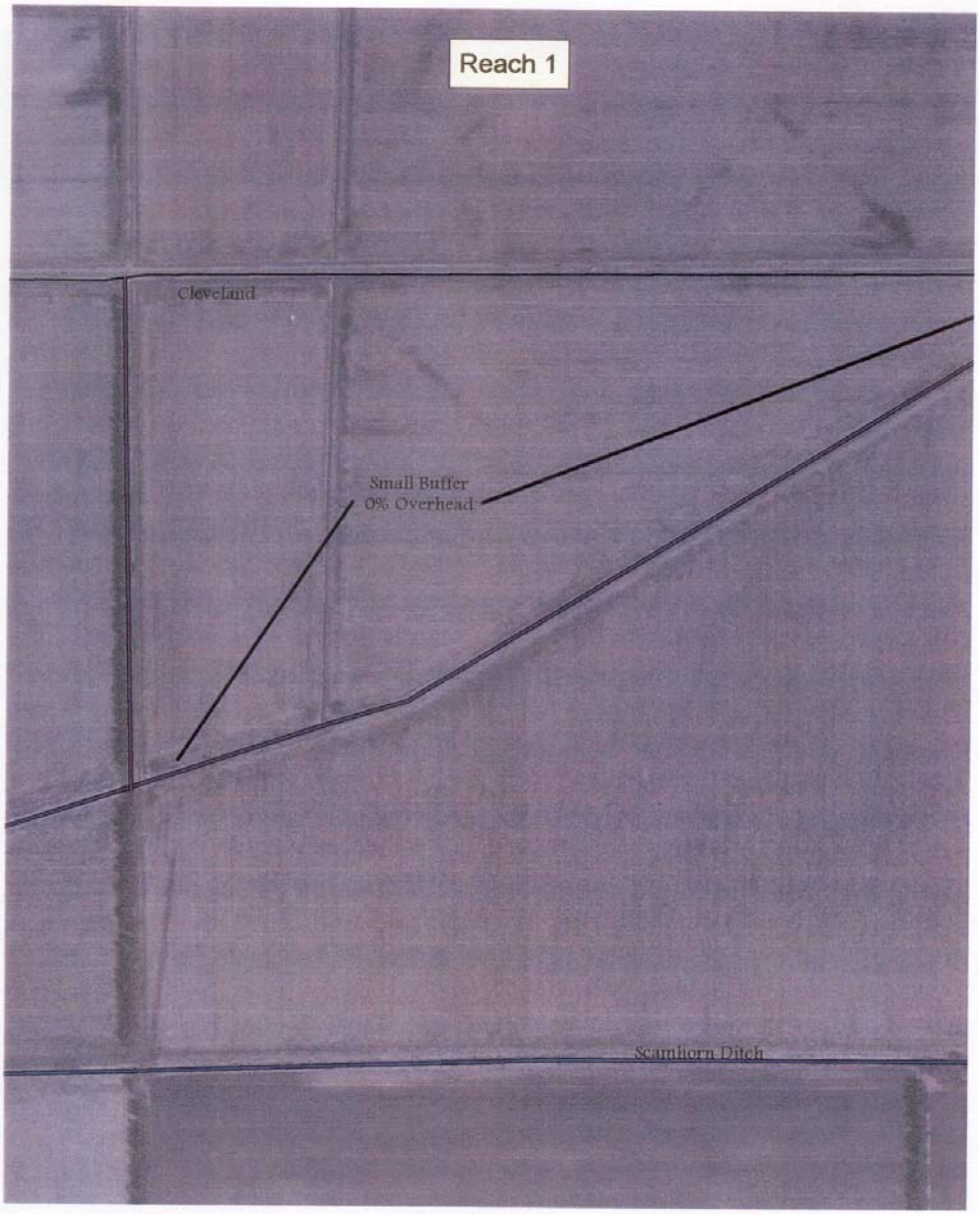
1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 15

JFNA 00-01-12

J.F. New & Associates, Inc.
708 Rosemont Road
P.O. Box 243
Waterloo, IN 46574
Phone: 219-588-3400
FAX: 219-588-3448
Permitting - Delineations - Mitigation Design - Biological Inventories
Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment



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1"=500'

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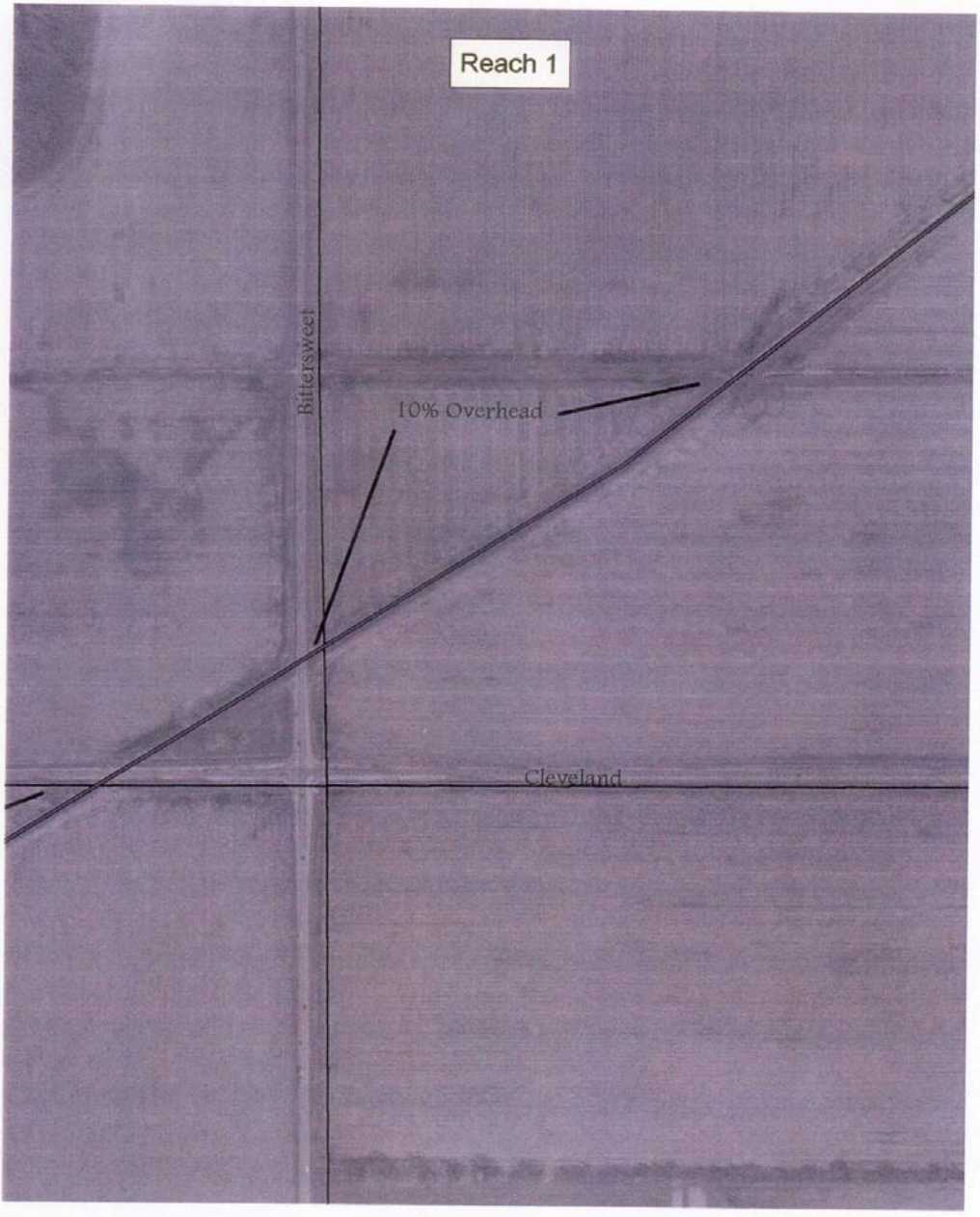
Juday Creek
Engineering Feasibility Study
Field Survey
Tile 16

JFNA 00-01-12

J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 343
Walkerton, IN 46574
Phone: 219-586-3400
FAX: 219-586-3446
Permitting - Delineations - Mitigation Design - Biological Inventories
Wetland and Prairie Nursery - Lake and Stream Enhancement
Natural Systems for Wastewater Treatment



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1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 17

JFNA 00-01-12

J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 243
Walkerton, IN 46574
Phone: 219-586-3400
Fax: 219-586-3448
Permitting • Delineations • Mitigation Design • Biological Inventories
Wetland and Prairie Nursery • Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

500 0 500 Feet

1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 18

JFNA 00-01-12

J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 243
Watseka, IL 60970
Phone: 815-432-2400
FAX: 815-432-2448
Permitting • Delineations • Mitigation Design • Biological Inventories
Wetland and Prairie Nursery • Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

500 0 500 Feet

1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 19

JFNA 00-01-12

J.F. New & Associates, Inc.
108 Roosevelt Road
P.O. Box 343
Walkerton, IN 46574
Phone: 219-586-3400
FAX: 219-586-3445
Permitting • Delineations • Mitigation Design • Biological Inventories
Wetland and Prairie Nursery • Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

500 0 500 Feet

1"=500'

N

Juday Creek
Engineering Feasibility Study
Field Survey
Tile 20

JFNA 00-01-12

J.F. New & Associates, Inc.
108 Rosecrest Road
P.O. Box 343
Belleville, WI 53508
Phone: 608-588-3400
FAX: 608-588-3448
Permitting • Delineations • Mitigation Design • Biological Inventories
Wetland and Prairie Nursery • Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

APPENDIX C

PERMIT APPLICATION FORMS

JUDAY CREEK FEASIBILITY STUDY
ST. JOSEPH COUNTY, INDIANA

STATE OF INDIANA
DEPARTMENT OF NATURAL RESOURCES

JOINT PERMIT APPLICATION FOR CONSTRUCTION WITHIN A FLOODWAY OF A STREAM OR RIVER; NAVIGABLE WATERWAY; PUBLIC FRESH WATER LAKE; AND DITCH RECONSTRUCTION

*** INSTRUCTIONS ***

This joint application can be used to apply for: (1) alteration of the bed or shoreline of a public freshwater lake; (2) construction or reconstruction of any ditch or drain having a bottom depth lower than the normal water level of a freshwater lake of 10 acres or more and within 1/2 mile of the lake; (3) construction within the floodway of any river or stream; (4) placing, filling, or erecting a permanent structure in; water withdrawal from; or material extraction from; a navigable waterway; (5) extraction of mineral resources from or under the bed of a navigable waterway; and (6) construction of an access channel. **You must submit readable copy of the completed application form together with items stated in the "Application Checklist" (attached).**

Use the following checklist to determine which permit(s) to apply for. If you have trouble deciding which permit(s) you need, please contact the Permit Administration Section at (317) 233-5635.

Your project may require one or more of the following permits. **IF YOU CHECK ANY BOX UNDER A PERMIT TITLE, THEN YOU MUST APPLY FOR THAT PERMIT.**

☐ IC 14-26-2: **Lake Preservation Act** states that no person may change the level of the water or shoreline of a public freshwater lake by excavating, filling in, or otherwise causing a change in the area or depth or affecting the natural resources scenic beauty or contour of the lake below the waterline or shoreline, without first securing the written approval of the Department of Natural Resources. A written permit from the Department is also required for construction of marinas; new seawall; seawall refacing; underwater beaches; boatwells; boat well fills; fish attractors; and any permanent structures within the waterline or shoreline of a public freshwater lake. The Act further states that **each permit application must be accompanied by a non-refundable $25 fee.**

☐ IC 14-26-5: **Lowering of the Ten Acre Lake Act also know as the "Ditch" Act** states that no person may order or recommend the location, establishment, construction, reconstruction, repair, or recleaning any ditch or drain having a bottom depth lower than the normal water level of a freshwater lake of 10 acres or more and within 1/2 mile of the lake without first securing the written approval of the Department of Natural Resources. The Act further states that **each permit application must be accompanied by a non-refundable $25 fee.**

☐ IC 14-28-1: **Flood Control Act** requires that any person proposing to construct a structure, place fill, or excavate material within the floodway of any river or stream must obtain the written approval of the Department of Natural Resources prior to initiating the activity. The Act further states that **each permit application must be accompanied by a non-refundable $50 fee.**

☐ IC 14-29-1: **Navigable Waterways Act** requires that prior written approval be obtained from the Department of Natural Resources for placing, filling, or erecting a permanent structure in; water withdrawal from; or mineral extraction from; a navigable waterway or Lake Michigan. **No Fee**

☐ IC 14-29-3: **Sand and Gravel Permits Act** requires that prior written approval be obtained from the Department of Natural Resources for removal of sand, gravel, stone, or other mineral or substance from or under the bed of a navigable waterway. The Act further states that **each permit application must be accompanied by a non-refundable $50 fee.**

☐ IC 14-29-4: **Construction of Channels Act** requires that prior written approval of the Department of Natural Resources be obtained for construction of an artificial; or the improved channel of a natural watercourse; connecting to any river or stream for the purpose of providing access by boat or otherwise to public or private industrial, commercial, housing, recreational, or other facilities. **Each permit application must be accompanied by a non-refundable $100 fee.**

Mail To: Division of Water
Department of Natural Resources

PERMIT APPLICATION

402 West Washington Street, Room W264
Indianapolis, Indiana 46204-2748
Telephone Number: (317) 233-5635
Fax Number: (317) 233-4579

Approved by the State Board of Accounts(Pending)

AGENCY USE ONLY		
Application # _____	Section Coordinates	UTM North_____ UTM East_____
30 Day Notice _____	Fee Submitted $_____ Check # _____	Receipt # _____

Based on the "INSTRUCTIONS", I am submitting this application to perform work under:

- ☐ *IC 14-26-2 Lake Preservation Act*
- ☐ *IC 14-26-5 Lowering of the Ten Acre Lake Act*
- ☐ *IC 14-28-1 Flood Control Act*
- ☐ *IC 14-29-1 Navigable Waterways Act*
- ☐ *IC 14-29-3 Sand and Gravel Permits Act*
- ☐ *IC 14-29-4 Construction of Channels Act*

PLEASE TYPE OR PRINT

1. APPLICANT INFORMATION

Name of Applicant _____ Name of Contact Person _____

Mailing Address _____
(Street, P.O. Box or Rural Route)

_____ _____ _____
City State Zip Code

Daytime Telephone Number (___) _____ Fax Number (___) _____

2. AGENT INFORMATION

Name of Authorized Agent _____ Name of Contact Person _____

Mailing Address _____
(Street, P.O. Box or Rural Route)

_____ _____ _____
City State Zip Code

Daytime Telephone Number (___) _____ Fax Number (___) _____

3. PROPERTY OWNER INFORMATION

Name of Property Owner _____ Name of Contact Person _____

Mailing Address _____
(Street, P.O. Box or Rural Route)

_____ _____ _____
City State Zip Code

Daytime Telephone Number (___) _____ Fax Number (___) _____

Relationship of applicant to property: ☐ Owner ☐ Purchaser ☐ Leesee ☐ Other_____

7.	DISTURBED AREA DRAWING
7.1 Drawing Requirements: (See Application Information Packet)	

8.	PROJECT PHOTOGRAPHS
8-1 Images: (See Application Information Packet)	
8-2 Photo Orientation Map: (See Application Information Packet)	
8-3 Photo Documentation: (See Application Information Packet)	

9.	RELATED PROJECT INFORMATION
Department of Natural Resources	
Administrative Cause #	Related Application(s) #
Early Coordination #	Utility Exemption #
Recommendation #	Violation #
Department of Environmental Management	
Section 401 #	
Corps of Engineers	
Public Notice #	Section 10 Application #
Section 404 Application #	

10.	STATEMENT OF AFFIRMATION

I hereby swear or affirm, under the penalties for perjury, that the information submitted herewith is to the best of my knowledge and belief, true, accurate and complete, and that the property owner (s), and adjoining landowners have been notified of the activity. I further certify that I possess the authority to undertake the proposed or completed activities. I hereby grant to the Department of Natural Resources, the right to enter the above-described location to inspect the proposed or completed work.

_____ _____

Signature of Applicant or Authorized Agent *(REQUIRED)* **Date**

11.	REGULATORY FEES
11-1 Regulatory Fees Submitted: (See Application Information Packet)	
11-3 Payment Method: (See Application Information Packet)	

REQUIREMENT FOR ADDITIONAL INFORMATION AND PERMITS
Application made to and approval granted by the Department of Natural Resources does not in any way relieve the applicant of the necessity of securing easements or other property rights, permits and approvals from affected property owners and other local, state, and federal agencies.

4. AFFIRMATION OF PERSONAL SERVICE, 1ST CLASS MAIL SERVICE, OR CERTIFIED MAIL SERVICE

I have provided public notice to the listed property owners in conformance with the provisions of IC 14-11-4 and 310 IAC 0.6 through the method indicated below.
(Check the appropriate Box - *Please make copies of this blank page if additional pages are required*)

Property Owner (if not applicant or adjacent landowner) Address City State Zip Code	☐ Personal Service was provided on :_____ (date) ☐ 1st Class Mail Service was provided on: _____(date) I affirm that 21 days have passed without the mailing returned as undelivered or undeliverable. PS Form 3817 is attached as proof of mailing. ☐ Certified Mail service was provided on:_____(date) PS Form 3811 (green card) is attached as proof of mailing.
Adjacent Landowner: Address City State Zip Code	☐ Personal Service was provided on :_____ (date) ☐ 1st Class Mail Service was provided on: _____(date) I affirm that 21 days have passed without the mailing returned as undelivered or undeliverable. PS Form 3817 is attached as proof of mailing. ☐ Certified Mail service was provided on:_____(date) PS Form 3811 (green card) is attached as proof of mailing.
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5.	PROJECT DESCRIPTION
5.1 Description Narrative: (See Application Information Packet)	
6.	PROJECT LOCATION
6-1 Location Narrative: (See Application Information Packet)	
Stream/Lake Name	
6-2 Driving Directions: (See Application Information Packet)	
6-3 Special Information: (See Application Information Packet)	
6-4 Project Location Map: (See Application Information Packet)	
6-5 Project Site Map: (See Application Information Packet)	

LICATION FOR DEPARTMENT OF THE ARMY PERMIT
(33 CFR 325)

OMB APPROVAL NO. 0710-003
Expires October 1996

ic reporting burden for this collection of information is estimated to average 5 hours per response, including the time for reviewing instructions, :hing existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments :ding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of nse, Washington Headquarters Service Directorate of Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 2-4302; and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003), Washington, DC 20503. Please DO NOT URN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location e proposed activity.

'RIVACY ACT STATEMENT
ority: 33 U.S.C. 401, Section 10; 1413, Section 404. Principal Purpose: These laws require permits authorizing activities in, or affecting, navigable rs of the United States, the discharge of dredged or fill material into waters of the United States, and the transportation of dredged material for the ose of dumping it into ocean waters. Routine Uses: Information provided on this form will be used in evaluating the application for a permit. losure: Disclosure of requested information is voluntary. If information is not provided, however, the permit application cannot be processed nor can a it be issued.

set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this cation (see sample drawings and instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. pplication that is not completed in full will be returned.

MS 1 THRU 4 TO BE FILLED BY THE CORPS)

'PLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETED

AS BELOW TO BE FILLED BY APPLICANT)

PPLICANT'S NAME	8. AUTHORIZED AGENT'S NAME AND TITLE (AN AGENT IS NOT REQUIRED) J.F. New & Associates, Inc. c/o
PPLICANT'S ADDRESS	9. AGENT'S ADDRESS 708 Roosevelt Road, Walkerton, IN 46574
PPLICANT'S PHONE NOS. W/ AREA CODE siness ax	10. AGENT'S PHONE NOS. W/ AREA CODE a. Business 219-586-3400 b. Fax 219-586-3446

'ATEMENT OF AUTHORIZATION

by authorize J.F. New & Associates, Inc. to act in my behalf as my agent in the processing of this application and to furnish, upon request, emental information in support of this permit application.

PLICANT'S SIGNATURE DATE

E, LOCATION AND DESCRIPTION OF PROJECT OR ACTIVITY

'ROJECT NAME OR TITLE (see instructions)

NAME OF WATERBODY, IF KNOWN (see instructions) 14. PROJECT STREET ADDRESS (If applicable)

LOCATION OF PROJECT

COUNTY STATE

)THER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

)IRECTIONS TO THE SITE:

NATURE OF ACTIVITY (Description of project, include all features)

PROJECT PURPOSE (Describe the reason or purpose of the project, see instructions)

USE BLOCKS 20-22 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

REASON(S) FOR DISCHARGE

TYPE(S) OF MATERIAL BEING DISCHARGED AND THE AMOUNT OF EACH TYPE IN CUBIC YARDS

SURFACE AREA IN ACRES OF WETLANDS OR OTHER WATERS FILLED (see instructions)

IS ANY PORTION OF THE WORK ALREADY COMPLETE? YES ___ NO _ IF YES, DESCRIBE THE COMPLETED WORK.

ADDRESSES OF ADJOINING PROPERTY OWNERS, LESSEES, ETC., WHOSE PROPERTY ADJOINS THE WATERBODY (If more than can be entered here, please attach a supplemental list).

LIST OF OTHER CERTIFICATIONS OR APPROVALS/DENIALS RECEIVED FROM OTHER FEDERAL, STATE OR LOCAL AGENCIES FOR WORK DESCRIBED IN THIS APPLICATION.

NCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED

)uld include but is not restricted to zoning, building and flood plain permits.

Application is hereby made for a permit or permits to authorize the work described in this application. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT DATE SIGNATURE OF AGENT DATE

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

Indiana Department of Environmental Management
Office of Water Management
Section 401 Water Quality Certification Program

Regional General Permit - IDEM Notification Form

1. Applicant Information

Applicant:

Contact person:

Address:

Phone:

2. Project Location

County:

USGS Quadrangle:

Township:	Range:	Section:
UTM North:	Road Directions:	
UTM East		

3. Existing Conditions

Wetlands:	Acreage:

Wetland type: N/A

Stream:	Stream Name:
Open Water:	Open water type:

4. Project Impacts

Activity description:

Acres of wetland impact:

Linear feet of stream/ditch impact:	Acres of open water impact:

Area of riprap below the Ordinary High Water Mark:

State or Federal listed species documented within ½ mile radius of project site by Indiana Natural Heritage Center *(will be verified by IDEM)*:

Submit this form and a copy of the USGS Quadrangle map showing the location of the project clearly denoted on the map to:

IDEM
Section 401 WQC Program
100 N Senate Avenue, Room 1255
Indianapolis, Indiana 46206-6015

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Office of Water Quality

Application Form and Instructions for Authorization to Discharge Dredged or Fill Material to a Water of the State

Note to applicants:

This form may be used to request either a water quality certification pursuant to section 401 of the Clean Water Act or an NPDES permit pursuant to 327 IAC 5. It may also be used to request a review of a proposed project by IDEM to determine whether the project will violate water quality standards. Applicants with discharges covered by an effluent limitation guideline should not use this application but instead contact Mr. Steve Roush (317) 232-8706 for the appropriate application form.

Applicants should also contact the Indiana Department of Natural Resources (DNR) regarding potential permit requirements associated with construction in a floodway or a public freshwater lake. You can reach the DNR Division of Water at 317-232-4160 or toll free at 1-877-WATER55.

Revised June 6, 2001

Instructions for Completing the Application

Address all applications or questions to:
Indiana Department of Environmental Management
Water Quality Standards Section
100 North Senate Avenue, P.O. Box 6015
Indianapolis, Indiana 46206-6015
1-800-451-6027 or 317-233-8488

The numbers below correspond to the section numbers on the application form.

Print clearly or type.

Attach additional 8.5" x 11" sheets if necessary.

1. Provide the applicant's name, address, and telephone number. Applicants MUST provide a contact name.

2. Provide the agent's address and telephone information (an agent is anyone representing the applicant on the project, such as an attorney or consultant). Applicants are not required to have an agent.

3. Provide specific project information relating to the location of the proposed project. Include the Universal Transverse Mercator (UTM) coordinates including the datum (e.g. 1927 North American). UTM coordinates can be obtained from the United States Geological Survey (USGS) 7.5-Minute Series Topographic Quadrangle maps.

4. Provide the proposed start date and the anticipated completion date. If you have started your project before obtaining authorization, you may be in violation of federal and/or state law. Give a narrative description of the proposed project. Describe the purpose of the project; what goal or outcome will be met by the construction of the project.

5. Include all impacts with the appropriate unit of measure. If you can avoid impacts to wetlands and other waterbodies, you may be able to avoid the requirement to obtain authorization from IDEM. Minimization of the impacts may decrease any compensatory mitigation requirements that might otherwise apply and increase the chances of receiving authorization. If the compensatory mitigation involves the creation or restoration of wetlands or other waterbodies, IDEM will require separate compensatory mitigation plan. If you need guidance on the information required in a complete mitigation plan, contact IDEM.

6. Drawing/Plan requirements. All applicants must submit drawings/plans consistent with the specifications under item six.

7. **For all projects involving impacts to wetlands,** a wetland delineation using the procedures established in the U.S. Army Corps of Engineers Wetland Delineation Manual, Technical Report Y-87-1 (January 1987) is **required.** Photographs aid the department in deciding if a site investigation is necessary and how best to locate the impact areas when site investigations are necessary.

Instructions are continued immediately after the application form.

Application for Authorization to Discharge Dredged or Fill Material to a Water of the State
State Form # 48598 (6-01)

***Only the Application Pages need to be mailed to IDEM.**

1. APPLICANT INFORMATION		2. AGENT INFORMATION	
Name of Applicant:		Name of Agent:	
Mailing address (Street/ PO Box/ Rural Route, City, State, Zip):		Mailing address (Street/ PO Box/ Rural Route, City, State, Zip):	
Daytime Telephone Number:		Daytime Telephone Number:	
Fax Number:		Fax Number:	
E-mail address (optional):		E-mail address (optional):	
Contact person (required):		Contact person:	
3. PROJECT LOCATION			
County:		Nearest city or town:	
U.S.G.S. Quadrangle map name (Topographic map):		Project street address (if applicable):	
Quarter:	Section:	Township:	Range:
Type of aquatic resource(s) to be impacted (lake, river, stream, ditch, wetland, etc. Include name if applicable):		Project name or title (if applicable):	
		UTM North:	UTM East:
Other location descriptions or driving directions:			
4. PROJECT PURPOSE and DESCRIPTION *(Use additional sheet(s) if required)*			
Has any construction been started? YES NO		Anticipated start date:	
If yes, how much work is completed?			

Project purpose and description:

5. Project Information: Applicants must answer all the following questions *(Use additional sheet(s) if required)*
What are the linear feet of impacts to the waterbody below the ordinary high water mark (OHWM) and/or bank clearing?
What is the acreage or square footage of wetlands or other water resources that are proposed to receive a discharge of material (ie. fill), to be mechanically cleared, or to be excavated?
What is the area of wetlands or other water resources on the site, in acreage or square feet?
Describe the type, composition and quantity (in cubic yards) of fill material to be placed in the wetland or below the OHWM of the water to receive the material (wetland or other water to be filled).
Describe the type, composition and quantity (in cubic yards) of material proposed to be removed from the wetland or below the OHWM of the water resource.

Describe the alternative project locations and/or design configurations that you considered or implemented to avoid and/or minimize impacts to wetlands and other waterbodies to the greatest extent possible.

Describe any proposed compensatory mitigation for unavoidable impacts.

6. **Drawing/Plan Requirements** (applicants must provide the following)

a. Top/aerial/overhead view of the project site.

b. Cross sectional view.

c. North arrow, scale, property boundaries.

d. Include wetland delineation boundary (if applicable). Label the impact wetlands as I-1, I-2, I-3, etc. and the mitigation areas as M-1, M-2, etc..

e. Location of all surface waters, including wetlands, erosion control measures, existing and proposed structures, fill and excavation locations, disposal area for excavated material, including quantities, and wetland mitigation site (if applicable).

f. Approximate water depths and bottom configurations (if applicable).

g. Provide plans on 8" x 11"-inch paper, unless directed otherwise.

7. **Documentation Requirements** (applicants must provide the following)

a. A wetland delineation for projects with wetland impacts (approved by Corps of Engineers if a Section 404 permit is required).

b. Photographs of the project site. Indicate where they were taken on the overhead view of the project plans.

8. **Additional information that MAY be required** (IDEM will notify you if needed)

a. Erosion control and/or storm water management plans.

b. Sediment analysis.

c. Compensatory mitigation plan including type, size, location, methods of construction, planting & monitoring plans, and criteria for success.

d. Species surveys for fish, mussels, plants and threatened or endangered species.

e. Any other information IDEM deems necessary to review the proposed project.

9. Permitting Requirements

a. Does this project require the issuance of a Department of the Army Section 404 Permit from the US Army Corps of Engineers? If no, you do not need to answer Part b.

b. Have you applied for an Army Corps of Engineers Section 404 permit? If yes, please supply the Corps of Engineers ID Number, the Corps of Engineers District, the project manager, and a copy of any correspondence with the Corps. **If no, contact** the Army Corps of Engineers regarding the possible need for a permit application. (See instruction #9.)

c. Have you applied for, received, or been denied any other federal, state, or local permits, variances, licenses, or certifications for this project? Please give the permit name, agency from which it was obtained, permit number, and date of issuance or denial.

10. Adjoining Property Owners and Addresses

List the names and addresses of landowners adjacent to the property on which your project is located and the names and addresses of other persons (or entities) potentially affected by your project. Use additional sheet(s) if required.

Name Address City State Zip	Name Address City State Zip
Name Address City State Zip	Name Address City State Zip
Name Address City State Zip	Name Address City State Zip

11. Fee Submittal

If applying for authorization under an IDEM NPDES permit, please enclose with the application a check or money order for $50.00 made payable to Indiana Department of Environmental Management (IDEM).

12. Signature - Statement of Affirmation

I certify that I am familiar with the information contained in this application and, to the best of my knowledge and belief, such information is true and accurate. I certify that I have the authority to undertake and will undertake the activities as described in this application. I am aware that there are penalties for submitting false information. I understand that any changes in project design subsequent to IDEM's granting of authorization to discharge to a water of the state are not authorized and I may be subject to civil and criminal penalties for proceeding without proper authorization. I agree to allow representatives of the IDEM to enter and inspect the project site. I understand that the granting of other permits by local, state, or federal agencies does not release me from the requirement of obtaining the authorization requested herein before commencing the project.

Applicant's Signature: _____ **Date:** _____

Print Name: _____ **Title:** _____

Instructions continued

8. Applicants are not required to submit the information specified in this section unless directed to do so by the department. However, applicants may submit the information if they anticipate that such information will be required.

9. Some projects involving impacts to isolated waterbodies, including wetlands, may not require the issuance of a Department of the Army permit. These activities are still subject to the provisions of State law. Please provide documentation from the Corps as to whether a Section 404 permit will be required. Your application may not be processed until this information is provided. The U.S. Army Corps of Engineers can be contacted at 502-315-6733 for the Louisville Corps District or at 313-226-2218 for the Detroit Corps District.

10. Adjacent property owner information must be provided for the purpose of providing public notice. IDEM requires the names and addresses of all property owners adjoining the property in which the project is to occur.

11. A permit fee is required for the process on IDEM NPDES permits. The application will not be reviewed until the application fee is submitted to IDEM.

12. The applicant must sign and date the application.

Where to get additional information

APPENDIX D

COMMUNICATION WITH AGENCIES AND PROPERTY OWNERS

1. State Agencies
2. Federal Agencies
3. Property Owners
- A. Heller
- B. B & R Oil Company
- C. Residents between Douglas and Ironwood Roads
- D. Ziolkowski
- E. Windingbrook Residents

JUDAY CREEK FEASIBILITY STUDY
ST. JOSEPH COUNTY, INDIANA

1. Communication with State Agencies

STATE OF INDIANA

INDIANA DEPARTMENT OF TRANSPORTATION

Governor Frank O'Bannon

TOLL ROAD DISTRICT
Post Office Box 1
Granger, Indiana 46530-0001
(219) 674-8836

December 5, 2001

Mr. John B. Richardson
Senior Project Manager
J. F. New & Associates, Inc.
708 Roosevelt Road • P.O. Box 243
Walkerton, IN 46574

RE: Juday Creek Stormwater Projects

Dear Mr. Richardson

After reviewing the sketches I see no problem with the feasibility of this project. Further more the Indiana Toll Road would like to give you its full and positive support.

Please at your earliest convenience send me more detailed information about this project. In other words a more detailed location (North right-of-way or South right-of-way), and a total length of the project with a starting, and ending point.

A break down on estimated quantities:

- Excavation
- Grading
- Stone
- Seeding

And any other related quantities.

The Indiana Toll Road will have an Asphalt Paving Contract in this area going out for bid on the June 2002 Letting. The information on the estimated quantities would allow us to include this work within the scope of this Contract, and have this portion of the project completed by the fall of 2002.

If you have any further questions you can call me at (219) 674-8836, ext. 432 or e-mail me at jlaskowski@toll.indot.state.in.us

Sincerely,

James J. Laskowski
Design/Permit Coordinator

MEMO

To: **John Richardson, JF New & Associates**
From: **Jill Hoffmann, IDNR**
Date: **03/21/02**
RE: **Juday Creek Study Review**

John, Doug Nusbaum, Kent Tracey and I have the following comments for you to consider regarding the Juday Creek Feasibility Study:

- Some concern over the cost estimate for the stream reroute/wetland filter (Holiday Inn & Hospice parking lots). Please provide more info describing this figure.
- Is there any evidence that supports the dredge (project 4) and fill (project 5) activities proposed for the streamside ponds? Why were these ponds targeted rather than others? We have to be cautious that the recommendations are technically sound and don't appear to be private property improvements rather than legitimate priorities.
- Project 7 should be referred to CRP
- Cost estimates for projects 8 & 9 seem high, please explain.
- Social costs for Project 3 neglect the fact that the *new* floodway would extend further into the 'unused' property north of the creek. To what extent/distance is this property unused?
- Project 4 references the success of the stream reconstruction on the Notre Dame golf course channel. Are the soils, morphology and flow similar at the proposed site? How are differences, if any, being accounted for?
- Several places in the 'permits required sections' of the report it states that "tentative approval of each agency is being sought with this draft." Hopefully, more direct contact is/has been made regarding this issue. Please address this.
- The Social Costs section for project 5 raises some concern over the location of the owners septic system to the creek. Please map this on the design (Figure 10) and discuss its current condition.
- Preliminary design of the Douglas Road wetland notes that the site is not currently wetland. Does the site possess the physical attributes to make a suitable wetland (soils, topography, etc.) What is the proposed size of the wetland? What volume of water is it intended to handle and for how long?
- Project 6 sounds like the bank erosion is a result of water velocity due to channelization. If in fact velocity is the problem why not look at grade control measures?

- The Land Owner Agreement section for Project 7 refers to "enrolling in the program", is this assumed to be CRP? LARE? Were the landowners made aware of *all* relevant programs and incentives? Do you need this information?
- The Summary of Cost Estimates and Schedule should include a prioritization of the projects. Where can we expect the 'biggest bang for the buck' so to speak?
- Projects 1-3 are located downstream of Juday 1 monitoring site, Why? How were monitoring sights selected? Any recommendations regarding monitoring to describe and/or evaluate water quality at these downstream project sites? Please map the proposed project sites in reference to the WQ monitoring sites.
- Why don't the Field Survey recommendations appear as part of the main report. It is hard to follow how certain recommendations relate to the nine projects specifically outlined in the report. For example, Stream Reach 4, an observation is made regarding a large retention pond between Douglas Road and Restoration site 36. The pond is noted as a "major thermal impact on the stream." Is this the Ziolkowski property? If not, why are Ziolkowski's ponds address and this is not? If it is the Ziolkowski property please help make these connections.
- Please add the location of proposed projects to the Tile figures in the Field Survey section.
- Project 1 did not appear in the first study. What factors elevated this area to one of concern? It is recommended that LARE fund this, yet it hasn't been document to be a priority, correct? Does any water quality data exist downstream of this site?
- Why was the funding source changed from USFWS to LARE for project 4? $107,185 is substantially more than the $17,443 originally proposed as a LARE project.

I enjoyed reviewing the many creative solution you have developed for Juday Creek. I look forward to future work in this watershed. As usual, thanks for your hard work on this study and positive outreach to local landowners! Call if you have questions about the above comments.

2. Communication with Federal Agencies

DEPARTMENT OF THE ARMY
DETROIT DISTRICT, CORPS OF ENGINEERS
REGULATORY OFFICE
SOUTH BEND FIELD OFFICE
2422 VIRIDIAN DRIVE SUITE # 101
SOUTH BEND, INDIANA 46628

February 5, 2002

IN REPLY REFER TO

File No. 02-171-000-0

John B. Richardson
J.F. New & Associates, Inc.
708 Roosevelt Road
Walkerton, Indiana 46574-0243

Dear Mr. Richardson:

This is in response to your request for comments regarding the draft *Juday Creek Engineering Feasibility Study* for selected water quality and habitat improvement projects. The study encompasses the entire watershed located in St. Joseph County, Indiana and Cass County, Michigan. Based on our review of the information you submitted, we provide the following comments for the Indiana portions of the proposal. Please contact the Michigan Department of Environmental Quality (MDEQ) for any work in Michigan.

The first of the recommended projects, labeled 3.1, is for erosion control surrounding the stormwater outlet at Kenilworth Road. The preliminary design alternative 2 involves the replacement of a collapsed section of pipe on top of a riprapped stabilized toe, resloping and seeding the bank above the stormwater outlet pipe. Based on the current design proposal, it appears that the project would qualify for the Indiana Regional General Permit (RGP) for New Construction. The Corps does not require notification where the footprint of the fill is less than 0.10 acre unless located in navigable waters. An application still must be submitted to the Indiana Department of Environmental Management (IDEM) and the Indiana Department of Natural Resources (IDNR) to qualify for the RGP.

The second project, labeled 3.2, proposes to reroute the stream and construct a wetland filter near the Holiday Inn and Hospice Parking Lots along U.S. 933. It appears that the project would provide improved water quality of the stream by diverting existing stormwater into a wetland filter. The conceptual plans do not contain adequate information to fully assess the project at this time.

Project 3.3 involves the reconstruction of 1,200 feet of Juday Creek between Ironwood and Douglas Roads. Unstable banks threaten adjacent property, streamside ponds connected to the creek contribute to thermal pollution, and the area lacks in-stream habitat. You propose to reconstruct the stream along this reach by narrowing the channel, revegetating with native plants,

restoring meanders, constructing pool habitat, and constructing bioengineered banks. Based on available information, it appears that this project would require extensive excavation and fill under the Corps' regulatory authority.

The fourth of the recommended projects, labeled 3.4, is located at a site referred to as the *Ziolkowski Property*. You propose to implement alternative 2 involving fill in the majority of the existing pond and relocating the stream channel. Additional activities may include channel stabilization measures and habitat improvement.

The project you describe as S*tormwater Reroute to Wetland Filter at Douglas Road*, labeled 3.5, does not appear to fall within Corps jurisdiction. This determination is based on the currently proposed design alternatives. If your plans change from those depicted in the draft feasibility study please submit them to this office for review.

Project 3.6 is described as *Habitat Improvement from Edison Lakes Parkway to Fir Road.* The proposed project includes using glacial stone and woody debris structures such as deflector and cover logs, lunker structures, and channel constrictors to provide stable banks while narrowing the channel at up to 100 locations along the 4,700 feet of the project area. Because this project involves such a lengthy stream reach and numerous channel modifications within that area, our permit evaluation will require that you submit detailed plan drawings and provide precise calculations of the area of stream channel to be impacted.

The projects labeled 3.7, *30-Foot Filter Strips from Capitol Avenue to Interstate 80/90,* and 3.8, *Infiltration Trench on South Side of Interstate 80/90*, do not appear to fall within Corps jurisdiction. If your plans change from those depicted in the draft feasibility study please submit them to this office for review.

In the report, you indicate that project 3.9, *Regraded Slope/Bank Stabilization of Ditch North of Intersate 80/90,* does not require a DA permit since all work would be above the Ordinary High Water Mark (OHWM) of the ditch. You are correct that any work above the OHWM does not require a DA permit, however, the plans suggest that the sideslope of the ditch would be graded to a 3:1 slope from the bottom elevation of the ditch in which case the work would be below the OHWM. In order to make a final determination for this project, we will require additional information regarding the exact nature of the work.

In summary, each of the projects will require a Department of the Army (DA) permit except as noted above. Some of the work may qualify for the Indiana RGP provided you obtain a site specific 401 Water Quality Certification from IDEM. You should be cautioned, however, that a final determination cannot be made until the final design has been completed indicating the exact area of impacts resulting from each project. Prior to implementation of any of the projects, you must submit final, detailed plan drawings along with a completed DA permit application.

Should you have any questions, please contact me at the above address or telephone (574) 232-1952. Please refer to File Number: 02-171-000-0.

Sincerely,

Gregory A. McKay

Gregory A. McKay
Project Manager
South Bend Field Office

Copy Furnished

Konik/Detroit District Office

IN REPLY REFER TO:

United States Department of the Interior

FISH AND WILDLIFE SERVICE

BLOOMINGTON FIELD OFFICE (ES)
620 South Walker Street
Bloomington, Indiana 47403-2121
(812) 334-4261 FAX 334-4273

January 25, 2002

Mr. John B. Richardson
J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 243
Walkerton, Indiana 46574

Project: Juday Creek Engineering Feasibility Study
Waterway: Juday Creek and lateral ditches
Work Type: Habitat and water quality improvement projects
County: St. Joseph

Dear Mr. Richardson:

This responds to your letter dated December 19, 2001, requesting our comments on the aforementioned project.

These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et. seq.) and are consistent with the intent of the National Environmental Policy Act of 1969, the Endangered Species Act of 1973, and the U. S. Fish and Wildlife Service's Mitigation Policy.

The proposed projects will have no significant adverse effect on wetlands or instream habitat and will in fact improve habitats and water quality within Juday Creek. No Federally endangered species will be affected. Based on a review of the information you provided, the U.S. Fish and Wildlife Service has no objections to the projects as currently proposed.

We appreciate the opportunity to comment at this early stage of project planning. Please keep us informed as project plans progress. For further discussion please call Elizabeth McCloskey at (219) 983-9753.

Sincerely yours,

Elizabeth S. McCloskey

Scott E. Pruitt
for Supervisor

3. Communication with Property Owners

Property Owners
A. Communication with Dr. Heller

Property Owners
B. Communication with B & R Oil Company

J. F. New & Associates, Inc.

08 Roosevelt Road • P.O. Box 243 • Walkerton, IN 46574
Phone: 219-586-3400 • Fax: 219-586-3446
Web: www.jfnew.com • E-Mail: info@jfnew.com

20 February 2002

Mr. Ralph Dobson
B & R Oil Company
227 E. Cleveland
Granger, IN 46530

Dear Mr. Dobson:

As we discussed, we are seeking your general approval of the conceptual idea of routing Juday Creek northward to create a stormwater filter on your property at US 933 and the Toll Road. With your approval (signature below), we will proceed with grant applications that will allow us to complete final designs. You will receive a copy of any grant application we submit to funding agencies and notification of any grants we receive for the project.

Sincerely,
J.F. New and Associates, Inc.

John B. Richardson
Senior Project Manager

I support the proposed project. Signed: R W Dobson

JF New File 000112

Property Owners
C. Communication with Residents between Douglas and Ironwood Roads

J. F. New & Associates, Inc.

08 Roosevelt Road • P.O. Box 243 • Walkerton, IN 46574
Phone: 219-586-3400 • Fax: 219-586-3446
Web: www.jfnew.com • E-Mail: info@jfnew.com

Jeffrey Sayre
17912 Edgewood Walk
South Bend, IN 46635

11 February 2002

Dear Jeff:

J. F. New and Associates, Inc. is working under a St. Joseph County Drainage Board sponsored grant to improve water quality and habitat in Juday Creek. We are proposing a project from Ironwood Road to Douglas Road that may affect your property. At this time the project is only conceptual in nature. Final designs and construction will not occur until after the majority of property owners on the reach support the project, grant funding is obtained, and it is approved by all of the regulatory agencies.

The conceptual project involves the reconstruction of the stream channel in order to increase stream habitat and reduce stream bank erosion. The concentrated flow will drive accumulated sediments through the system to expose the natural gravel bottom of the stream. The exposed gravel is required for environmentally sensitive fish species, such as the brown trout, for reproduction and feeding. Bank stabilization and stream reconstruction techniques could include a narrowing of the existing stream channel, an excavation of deep pools, filling inflow/outflow channels between streamside ponds and the existing stream channel and stabilizing the banks using glacial stone and native vegetation. A narrowing of the existing stream channel would increase sinuosity, increase flow velocity and keep find sediments moving through the stream. By moving the flow away from the banks of the creek, plants are more likely to become established at the waters edge and reduce the erosion that is occurring.

Attached is a map of your property for your preliminary design. I am seeking your opinion as to whether you would be in support of this type of work. Without your written support we will not proceed with the proposed project. Please provide me with a written response of how you feel about this project and if you have alternative ideas for enhancing the streams water quality and habitat.

Sincerely,

John B. Richardson
Senior Project Manager

Attachment

I support the proposed project. Signed: _____ 2/15/02

J. F. New & Associates, Inc.

08 Roosevelt Road • P.O. Box 243 • Walkerton, IN 46574
Phone: 219-586-3400 • Fax: 219-586-3446
Web: www.jfnew.com • E-Mail: info@jfnew.com

11 January 2002

Dear Sandra Berta:

J. F. New and Associates, Inc. is working under a St. Joseph County Drainage Board sponsored grant to improve water quality and habitat in Juday Creek. We are proposing a project from Ironwood Road to Douglas Road that may affect your property. Your neighbor, Jeff Sayre may have already contacted you regarding this project. At this time the project is only conceptual in nature. Final designs and construction will not occur until after the majority of property owners on the reach support the project, grant funding is obtained, and it is approved by all of the regulatory agencies.

Bank stabilization and stream reconstruction techniques could include a narrowing of the existing stream channel, an excavation of deep pools, filling inflow/outflow channels between streamside ponds and the existing stream channel and stabilizing the banks using glacial stone and native vegetation. A narrowing of the existing stream channel would increase sinuosity, increase flow velocity and keep find sediments moving through the stream. By moving the flow away from the banks of the creek, plants are more likely to become established at the waters edge and reduce the erosion that is occurring.

Attached is a drawing depicting one of several alterations of how the above work is accomplished. I am seeking your opinion as to whether you would be in support of this type of work. Without your written support we will not proceed with the proposed project. Please provide me with a written response of how you feel about this project and if you have alternative ideas for enhancing the streams water quality and habitat.

Sincerely,
J.F. New and Associates, Inc.

John B. Richardson
Senior Project Manager

Attachment

c. John McNamara, St. Joseph County Surveyor

I support the proposed project. Signed: Sandra M Berta

Native Plant Nursery • 128 Sunset • Walkerton, IN 46574 • Phone: 219-586-2412 • Fax: 219-586-2718
Indianapolis • 3955 Eagle Creek Parkway, Suite A • Indianapolis, IN 46254 • Phone: 317-388-1982 • Fax: 317-388-1986
Illinois • 722 West Exchange, Suite 4 • Crete, Illinois 60417 • Phone: 708-367-1130 • Fax: 708-367-1132

J. F. New & Associates, Inc.

708 Roosevelt Road • P.O. Box 243 • Walkerton, IN 46574
Phone: 219-586-3400 • Fax: 219-586-3446
Web: www.jfnew.com • E-Mail: info@jfnew.com

11 January 2002

Dear William and Dorothy Booker:

J. F. New and Associates, Inc. is working under a St. Joseph County Drainage Board sponsored grant to improve water quality and habitat in Juday Creek. We are proposing a project from Ironwood Road to Douglas Road that may affect your property Your neighbor, Jeff Sayre may have already contacted you regarding this project. At this time the project is only conceptual in nature. Final designs and construction will not occur until after the majority of property owners on the reach support the project, grant funding is obtained, and it is approved by all of the regulatory agencies.

Bank stabilization and stream reconstruction techniques could include a narrowing of the existing stream channel, an excavation of deep pools, filling inflow/outflow channels between streamside ponds and the existing stream channel and stabilizing the banks using glacial stone and native vegetation. A narrowing of the existing stream channel would increase sinuosity, increase flow velocity and keep find sediments moving through the stream. By moving the flow away from the banks of the creek, plants are more likely to become established at the waters edge and reduce the erosion that is occurring.

Attached is a drawing depicting one of several alterations of how the above work is accomplished. I am seeking your opinion as to whether you would be in support of this type of work. Without your written support we will not proceed with the proposed project. Please provide me with a written response of how you feel about this project and if you have alternative ideas for enhancing the streams water quality and habitat.

Sincerely,
J.F. New and Associates, Inc.

John B. Richardson
Senior Project Manager

Attachment

c. John McNamara, St. Joseph County Surveyor

I support the proposed project. Signed: _____

J. F. New & Associates, Inc.

'08 Roosevelt Road • P.O. Box 243 • Walkerton, IN 46574
Phone: 219-586-3400 • Fax: 219-586-3446
Web: www.jfnew.com • E-Mail: info@jfnew.com

11 January 2002

Dear William and Joann Chu:

J. F. New and Associates, Inc. is working under a St. Joseph County Drainage Board sponsored grant to improve water quality and habitat in Juday Creek. We are proposing a project from Ironwood Road to Douglas Road that may affect your property. Your neighbor, Jeff Sayre may have already contacted you regarding this project. At this time the project is only conceptual in nature. Final designs and construction will not occur until after the majority of property owners on the reach support the project, grant funding is obtained, and it is approved by all of the regulatory agencies.

Bank stabilization and stream reconstruction techniques could include a narrowing of the existing stream channel, an excavation of deep pools, filling inflow/outflow channels between streamside ponds and the existing stream channel and stabilizing the banks using glacial stone and native vegetation. A narrowing of the existing stream channel would increase sinuosity, increase flow velocity and keep find sediments moving through the stream. By moving the flow away from the banks of the creek, plants are more likely to become established at the waters edge and reduce the erosion that is occurring.

Attached is a drawing depicting one of several alterations of how the above work is accomplished. I am seeking your opinion as to whether you would be in support of this type of work. Without your written support we will not proceed with the proposed project. Please provide me with a written response of how you feel about this project and if you have alternative ideas for enhancing the streams water quality and habitat.

Sincerely,
J.F. New and Associates, Inc.

John B. Richardson
Senior Project Manager

Attachment

c. John McNamara, St. Joseph County Surveyor

I support the proposed project. Signed: _____

J. F. New & Associates, Inc.

08 Roosevelt Road • P.O. Box 243 • Walkerton, IN 46574
Phone: 219-586-3400 • Fax: 219-586-3446
Web: www.jfnew.com • E-Mail: info@jfnew.com

11 January 2002

Dear Timothy and Patricia McBride:

J. F. New and Associates, Inc. is working under a St. Joseph County Drainage Board sponsored grant to improve water quality and habitat in Juday Creek. We are proposing a project from Ironwood Road to Douglas Road that may affect your property. Your neighbor, Jeff Sayre may have already contacted you regarding this project. At this time the project is only conceptual in nature. Final designs and construction will not occur until after the majority of property owners on the reach support the project, grant funding is obtained, and it is approved by all of the regulatory agencies.

Bank stabilization/stream reconstruction techniques could include a narrowing of the existing stream channel, an excavation of deep pools, filling inflow/outflow channels between streamside ponds and the existing stream channel and stabilizing the banks using glacial stone and native vegetation. A narrowing of the existing stream channel would increase sinuosity, increase flow velocity and keep find sediments moving through the stream. By moving the flow away from the banks of the creek, plants are more likely to become established at the waters edge and reduce the erosion that is occurring. Additionally, a wetland filter would be constructed north of Douglas Road, just west of Juday Creek. The filter would be planted with native vegetation and would remove up to 90% of sediments and 45-75% of phosphorus, nitrogen and petroleum compounds off Douglas Road.

Attached are drawings depicting examples of how the above work is acomplished. I am seeking your opinion as to whether you would be in support of this type of work. Without your written support we will not proceed with the proposed project. Please provide me with a written response of how you feel about this project and if you have alternative ideas for enhancing the streams water quality and habitat.

Sincerely,
J.F. New and Associates, Inc.

John B. Richardson
Senior Project Manager

c. John McNamara, St. Joseph County Surveyor

I support the proposed project. Signed: _____

J. F. New & Associates, Inc.

108 Roosevelt Road • P.O. Box 243 • Walkerton, IN 46574
Phone: 219-586-3400 • Fax: 219-586-3446
Web: www.jfnew.com • E-Mail: info@jfnew.com

11 January 2002

Dear Michael and ~~Shirley~~ Shelly Daly ~~Daley~~:

J. F. New and Associates, Inc. is working under a St. Joseph County Drainage Board sponsored grant to improve water quality and habitat in Juday Creek. We are proposing a project from Ironwood Road to Douglas Road that may affect your property. Your neighbor, Jeff Sayre may have already contacted you regarding this project. At this time the project is only conceptual in nature. Final designs and construction will not occur until after the majority of property owners on the reach support the project, grant funding is obtained, and it is approved by all of the regulatory agencies.

Bank stabilization and stream reconstruction techniques could include a narrowing of the existing stream channel, an excavation of deep pools, filling inflow/outflow channels between streamside ponds and the existing stream channel and stabilizing the banks using glacial stone and native vegetation. A narrowing of the existing stream channel would increase sinuosity, increase flow velocity and keep find sediments moving through the stream. By moving the flow away from the banks of the creek, plants are more likely to become established at the waters edge and reduce the erosion that is occurring.

Attached is a drawing depicting one of several alterations of how the above work is accomplished. I am seeking your opinion as to whether you would be in support of this type of work. Without your written support we will not proceed with the proposed project. Please provide me with a written response of how you feel about this project and if you have alternative ideas for enhancing the streams water quality and habitat.

Sincerely,
J.F. New and Associates, Inc.

John B. Richardson
Senior Project Manager

Attachment

c. John McNamara, St. Joseph County Surveyor

I support the proposed project. Signed: Shelly Daly

Property Owners
D. Communication with Ms. Ziolkowski

J. F. New & Associates, Inc.

'08 Roosevelt Road • P.O. Box 243 • Walkerton, IN 46574
Phone: 219-586-3400 • Fax: 219-586-3446
Web: www.jfnew.com • E-Mail: info@jfnew.com

15 February 2002

Rosemary Ziolkowski
17700 Douglas Road
South Bend, IN 46635

Dear Ms. Ziolkowski:

J. F. New and Associates, Inc. is working under a St. Joseph County Drainage Board sponsored grant to improve water quality and habitat in Juday Creek. We are proposing a project that will affect your property. The pond on your land has silted in over the years to a maximum depth of about 2 feet. The pond causes thermal pollution to Juday Creek and cannot support fish in the shallow water.

The conceptually designed project involves filling the majority of the existing pond on your property. A conveyance channel will remain to carry water to the neighbor's pond. The remaining channel will be stabilized with stone or vegetation established on coir fiber lifts depending on your final design choices. Gravel could be placed on the bottom of the channel and overhanging trout habitat structures (lunkers), could be built into the banks of the newly established 2-3 foot wide channel. The design's primary function is to limit the thermal pollution from the pond. However, habitat improvement is an important secondary goal.

Attached is a **conceptual** drawing and rendering depicting how the above work is accomplished. I am seeking your opinion as to whether you would be in support of this type of work. Without your written support we will not proceed with the proposed project. Please provide me with a signature if you support the proposed project. If you have question, do not hesitate to call me.

Sincerely,
J.F. New and Associates, Inc.

John B. Richardson
Senior Project Manager

I support the proposed project. Signed: Rosemary Ziolkowski

JF New File 000112

Property Owners
E. Communication with Windingbrook Residents

J. F. New & Associates, Inc.

708 Roosevelt Road • P.O. Box 243 • Walkerton, IN 46574
Phone: 219-586-3400 • Fax: 219-586-3446
Web: www.jfnew.com • E-Mail: info@jfnew.com

30 November 2001

Dear Windingbrook Trails resident:

J. F. New and Associates, Inc. is working under a St. Joseph County Drainage Board sponsored grant to improve water quality and habitat in Juday Creek. We are proposing a project from Edison Lakes Parkway to Fir Road that may affect your property. At this time the project is only conceptual in nature. Final designs and construction will not occur until after the majority of property owners on this reach support the project, grant funding is obtained, and it is approved by the all of the regulatory agencies.

The conceptual project involves narrowing the creek in order to reduce bank erosion and concentrate flow. The concentrated flow will drive the accumulated sand and silt through the system to expose the natural gravel bottom of the stream. The exposed gravel is required by sensitive stream fish, such as the brown trout, for reproduction and feeding. The most environmentally sensitive way to narrow the stream in this reach is by strategically placing logs or boulders in the stream to direct the flow toward the center of the stream. By moving the flow away from the banks of the creek, plants are more likely to become established at the waters edge and reduce the erosion that is occurring.

Attached is a typical drawing of how the above work is accomplished. I am seeking your opinion as to whether you would be in support of this type of work. **Without your written support we will not proceed with the proposed project**. Please provide me with a written response of how you feel about this project and if you have alternative ideas for enhancing the streams water quality and habitat.

Sincerely,
J. F. New and Associates, Inc.

John B. Richardson
Senior Project Manager

Attachment

c. John McNamara, St Joseph County Surveyor

I support the proposal
Joseph L. Mathews
ARCHITECT A.I.A.
15525 HEARTHSTONE DR.
MISHAWAKA, IND 46545

Faith and Robert Tennyson
15605 Hearthstone Drive
Mishawaka IN 46545

December 18, 2001

John B. Richardson
J. F. New & Associates, Inc.
708 Roosevelt Road
PO box 243
Walkerton IN 46574

Dear Mr. Richardson;

Please consider this letter to be our written approval for your company to proceed with the project to narrow Juday creek as suggested in your letter of November 30, 2001. This approval is made under the assumption that our property (which is our back yard) will only be minimally effected by the project. That is, any construction would not encroach excessively into our yard and would be visually acceptable to us.

We consider ourselves fortunate to live on Juday Creek, and have been distressed over the past several years to notice increased erosion along the banks near our home.

I hope that if you do not receive an immediate positive response on this request from other property owners, you will pursue the issue with them to encourage their support. I think it is likely that some property owners may not be aware of the level of erosion because it is not easily visible from their prospective of the creek bank.

We would be pleased to support this or any project that would improve the health of the creek.

We look forward to hearing about your progress with this project.

Sincerely,

Faith Tennyson

ohnR

rom: Dusty
ent: Monday, January 07, 2002 8:24 AM
o: JohnR
ubject: FW: Juday Creek Project Proposal

----Original Message-----
'rom: Gayle L Cossman [mailto:glc530@juno.com]
ent: Sunday, January 06, 2002 8:00 PM
o: info@jfnew.com
ubject: Juday Creek Project Proposal

)ear Mr. New;

I am in support of the conceptual project involving the narrowing of .he creek in order to reduce erosion and concentrate flow. The bank ilong my property continues to erode, even though work was done, through ı previous grant, to help reduce erosion. This problem, in addition to .he loss of water quality and habitats, shows the need for action.

;incerely,

;ayle Cossman

.5655 Hearthstone

J. F. New & Associates, Inc.

708 Roosevelt Road • P.O. Box 248 • Walkerton, IN 46574
Phone: 219-586-3400 • Fax: 219-586-3446
Web: www.jfnew.com • E-Mail: info@jfnew.com

Wetland Delineations •
Permitting •
Mitigation Design •
Engineering •
Wetland/Prairie Nursery •
Land Planning •
Biological Inventories •
Natural Systems for Wastewater Treatment •
Lake and Stream Enhancement •
Ecological Restoration •

30 November 2001

Dear Windingbrook Trails resident:

J. F. New and Associates, Inc. is working under a St. Joseph County Drainage Board sponsored grant to improve water quality and habitat in Juday Creek. We are proposing a project from Edison Lakes Parkway to Fir Road that may affect your property. At this time the project is only conceptual in nature. Final designs and construction will not occur until after the majority of property owners on this reach support the project, grant funding is obtained, and it is approved by the all of the regulatory agencies.

The conceptual project involves narrowing the creek in order to reduce bank erosion and concentrate flow. The concentrated flow will drive the accumulated sand and silt through the system to expose the natural gravel bottom of the stream. The exposed gravel is required by sensitive stream fish, such as the brown trout, for reproduction and feeding. The most environmentally sensitive way to narrow the stream in this reach is by strategically placing logs or boulders in the stream to direct the flow toward the center of the stream. By moving the flow away from the banks of the creek, plants are more likely to become established at the waters edge and reduce the erosion that is occurring.

Attached is a typical drawing of how the above work is accomplished. I am seeking your opinion as to whether you would be in support of this type of work. **Without your written support we will not proceed with the proposed project.** Please provide me with a written response of how you feel about this project and if you have alternative ideas for enhancing the streams water quality and habitat.

Sincerely,
J. F. New and Associates, Inc.

Yes. I would support this Project if the cost is kept reasonable

John B. Richardson
Senior Project Manager

Attachment

c. John McNamara, St Joseph County Surveyor

Page Glase
15640 Winding Brook Dr
Mishawaka, IN 46545

SALOMON SMITH BARNEY
A member of citigroup

219-233-9400 • 800-322-2425

December 10, 2001

John B Richardson
Senior Project Manager
J F New & Associates
708 Roosevelt Road
P O Box 243
Walkerton, IN 46574

Dear John:

I think the idea of reclamation of Juday Creek as it was, as a trout stream is exciting. I would like to be kept informed as a property owner on the creek and the current president of the Winding Brook Park Association.

I look forward to further developments.

Sincerely,

Mark E Unwin

SALOMON SMITH BARNEY INC. 211 West Washington, Suite 2200, South Bend, IN 46601-1708 FAX 219-234-2484

APPENDIX E

BIOLOGICAL/HABITAT ASSESSMENT REPORT

JUDAY CREEK FEASIBILITY STUDY
ST. JOSEPH COUNTY, INDIANA

BIOLOGICAL/HABITAT ASSESSMENT REPORT

JUDAY CREEK ENGINEERING FEASIBILITY STUDY
ST. JOSEPH COUNTY, INDIANA

October 30, 2001

Prepared For:
St. Joseph County Drainage Board

Prepared By:
J.F. New & Associates, Inc.
708 Roosevelt Road
Walkerton, Indiana 46574
(219)-586-3400

BIOLOGICAL/HABITAT ASSESSMENT REPORT
JUDAY CREEK, ST. JOSEPH COUNTY, INDIANA

INTRODUCTION

In 2000, the St. Joseph County Drainage Board was issued a grant under the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) program. The grant funds were used to provide a feasibility study of anticipated construction projects and best management practices for specific stream Reaches 1 through 7 of Juday Creek in St. Joseph County as described by the approved application for LARE grant funding and the "Juday Creek Watershed Management Plan" completed in October, 1995 by Cole Associates, Inc. for the St. Joseph County Drainage Board.

On October 19, 2001 J.F. New conducted two surveys of fish, benthic macroinvertebrates, and habitat immediately downstream from several proposed project sites unless current studies already existed for those sites. Standard indices including the Index of Biotic Integrity (IBI), family-level Hilsenhoff Biotic Index (HBI), macroinvertebrate Index of Biotic Integrity (mIBI) and Qualitative Habitat Evaluation Index (QHEI) were used to determine the existing level of ecological integrity and predict impacts on sensitive species, biological communities, and water quality. These studies were established for future monitoring after construction of stream improvement projects to allow for scientific studies of improvements in the stream.

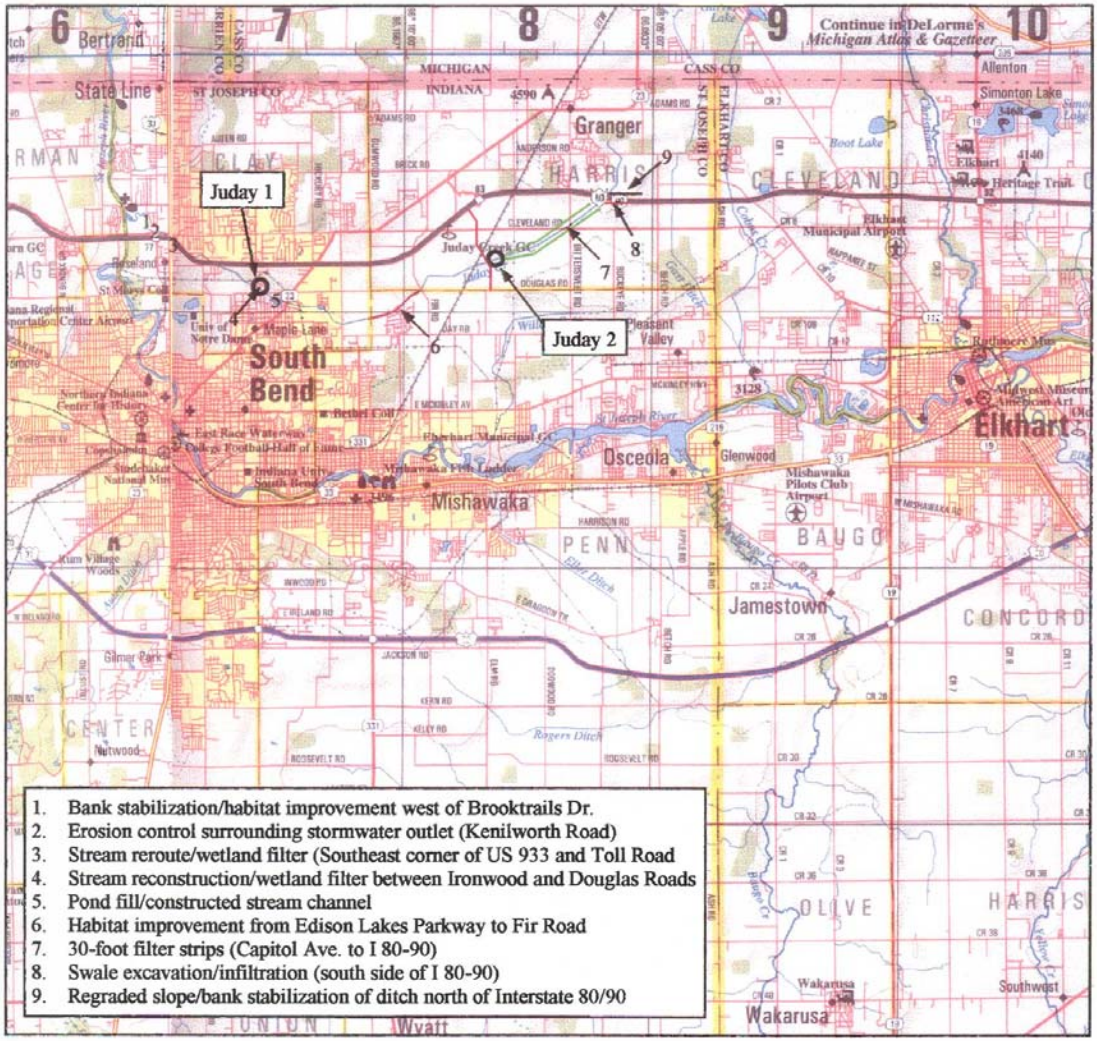
Juday Creek is a 2nd to 3rd order coldwater tributary of the St. Joseph River which lies entirely within the Northern Indiana Till Plain Ecoregion of Indiana. Historically, Juday Creek likely possessed good to excellent water quality and provided good habitat for less tolerant fish and macroinvertebrates. Agricultural, commercial, and residential development of the watershed has impaired the stream's original habitat. Development of a watershed typically increases silt loads, peak flows, and temperatures in a creek, all of which may in turn impact the stream's biological community. Despite the changes that have occurred within the Juday Creek Watershed, rainbow and brown trout as well as pollution sensitive macroinvertebrates still live and reproduce in the stream.

SITE DESCRIPTIONS

The two sites evaluated during this phase were selected based on the location of proposed stream improvement projects that might have a measurable affect on biological, water quality, and habitat conditions immediately downstream. A vicinity/site location map (Figure 1) as well as individual site location maps (Figures 2 and 4) and representative photos of survey sites (Figure 3) have been included for review.

Stream Access/Sample Locations

Juday 1: The Creek was accessed on October 19, 2001 from an adjacent landowner's property. The stream at this site drains approximately 27.1 sq. miles. The average width is approximately 19.3 feet. Electrofishing occurred along 380 feet of the stream. A site location map as well as reach photos may be found in Figures 2 and 3. Land use surrounding this reach is primarily

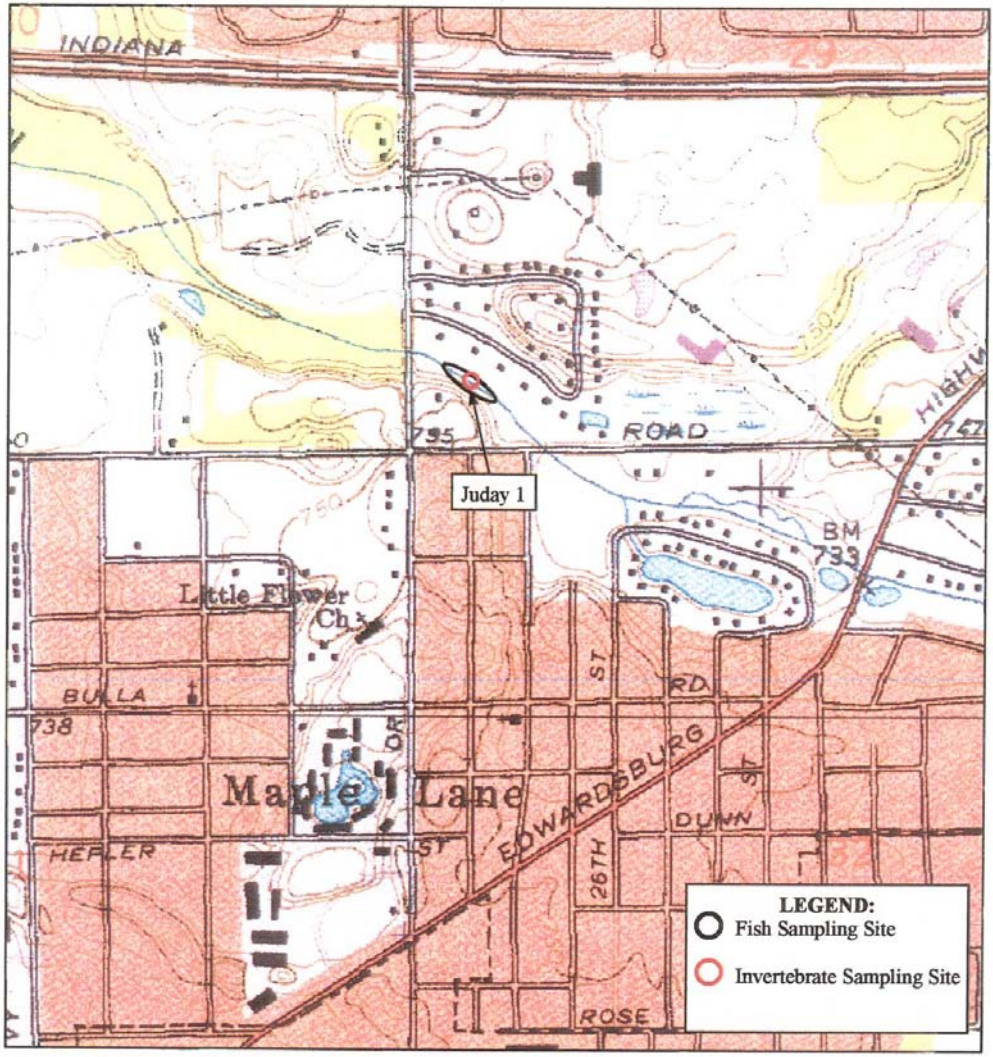


Scale: 1" = 2.5 Miles

JFNA# 00-01-12

Figure 1: Site Vicinity Map
2001 Biological Monitoring
St. Joseph County, Indiana

J.F. New & Associates



Scale: 1" = 1067'

JFNA# 00-01-12

Figure 2: **Juday 1 Site Location Map**
2001 Biological Monitoring
St. Joseph County, Indiana

J.F. New & Associates

Juday 1 facing southeast.

Juday 2 facing east.

JFNA# 00-01-12

Figure 3: **Reach Photographs**
2001 Biological Monitoring
St. Joseph County, Indiana

residential. Several landowners' have constructed streamside ponds that act as thermal pollutants during hot summer months. Bank stabilization is of primary importance in this reach. A meander in the stream threatens an adjacent home's foundation. Proposed stream bank projects in this reach include riprap, lunker structures, and glacial stone or stream relocation. Additionally, an eroded stormwater drain is present on the north side of Douglas Road. It delivers unfiltered stormwater directly into the study reach between Ironwood and Douglas Roads. The proposed fix involves rerouting stormwater to a constructed wetland filter on the north side of Douglas Road.

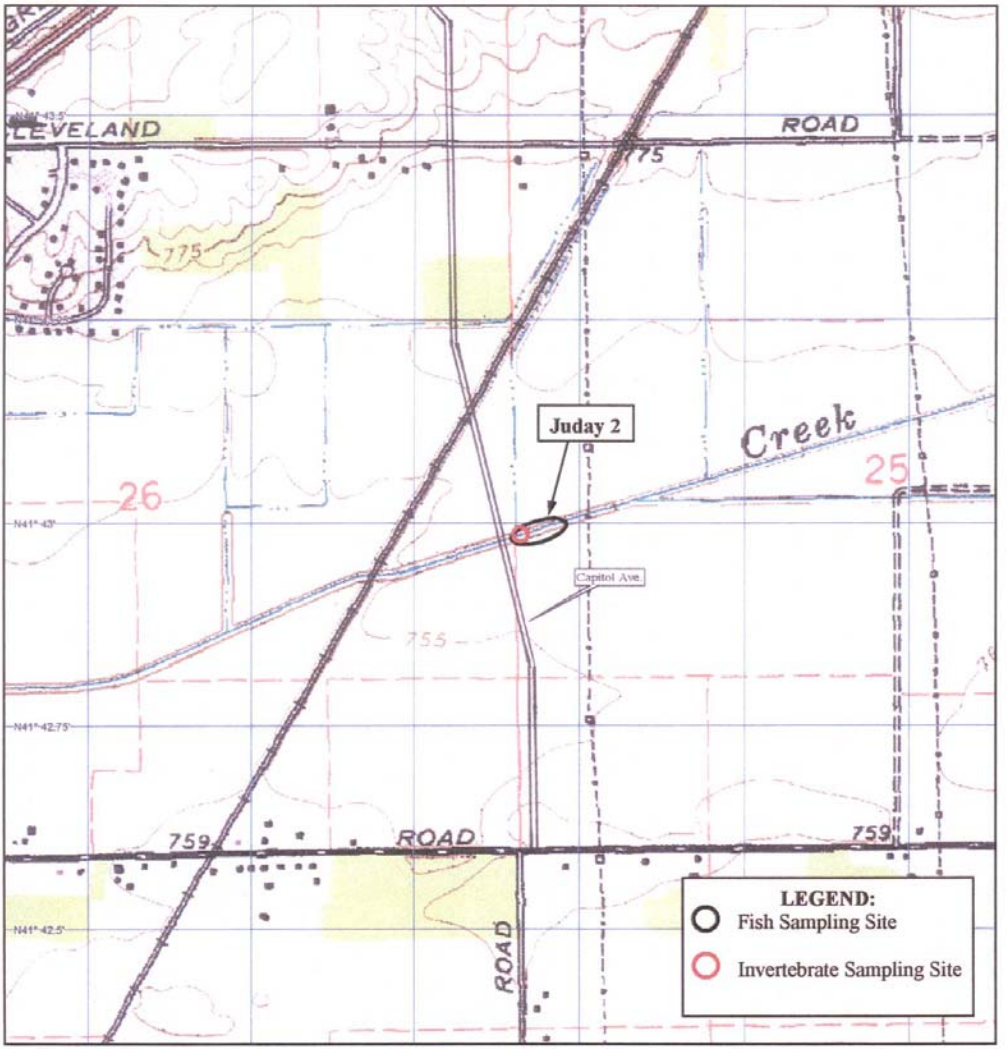
Juday 2: The Creek was accessed on October 19, 2001 from the east side of Capitol Avenue. The stream at this site drains approximately 13.5 sq. miles. The average width is approximately 18 feet and sampling occurred along 320 feet of the stream. Land use surrounding this reach was primarily agricultural. Farmed land is in close proximity to the stream. Proposed projects include a 30-foot wide buffer strip from Capitol Avenue to Interstate 80/90, bank resloping north of Interstate 80/90, and stormwater infiltration south of the interstate. A site location map and reach photos may be found in Figures 3 and 4

METHODS

Fish Sampling Methods

Fish sampling was conducted on October 19, 2001 and consisted of 28.2 minutes of electrofishing at Juday 1 and 19.5 minutes at Juday 2. A Cofelt Mark 10 backpack electrofishing unit was used to sample each site with one additional crewmember netting stunned fish. Both sites were sampled according to protocol established by Simon (1997). According to Simon's protocol, a reach of stream is sampled for 50 meters if the average width is <3.4 meters or 100 meters minimum distance for reaches >3.4 meters wide. These distances are sufficient to sample at least 15 times the stream width, a length generally long enough to include at least two riffle-pool habitat sequences (Leopold et al. 1964). Sampling includes both shorelines in streams >5 meters wide or follows a serpentine pattern on both shorelines for streams <5 meters wide. All fish encountered were collected, identified to species, measured, and returned to the water. Voucher specimens of unidentified species were preserved in 70% isopropyl alcohol and taken to the J.F. New laboratory for identification. Electrofishing data were used to calculate an Index of Biotic Integrity (IBI) at each site.

Biological communities reflect watershed conditions since they are sensitive to changes in a wide array of environmental factors (Karr 1981). Karr (1981) proposed that fish have numerous advantages as indicator organisms for biological monitoring programs. The Index of Biotic Integrity was first developed by Karr (1981) and modified by Simon (1997) for evaluating biotic integrity of warmwater stream fish communities located in the Northern Indiana Till Plain Ecoregion of Indiana. Karr and Dudley (1981) defined biological integrity as, "the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the best natural habitats within a region".



Scale: 1" = 1067'

JFNA# 00-01-12

Figure 4: **Juday 2 Site Location Map**
2001 Biological Monitoring
St. Joseph County, Indiana

The IBI is designed to assess biotic integrity directly through twelve attributes of fish communities in streams. These attributes fall into such categories as species richness and composition, trophic composition, and fish abundance and condition. After data from sampling sites have been collected, values for the twelve metrics are compared with their corresponding expected values (Simon 1997) and a rating of 1, 3, or 5 is assigned to each metric based on whether it deviates strongly from, somewhat from or closely approximates the expected values. The sum of these ratings gives a total IBI score for the site. The best possible IBI score is 60.

Juday Creek is classified as a coldwater stream. Simon's (1997) IBI expectations were developed primarily for warmwater streams. A major difference in fish distribution between coldwater and warmwater streams is readily observable: there are fewer species occurring in coldwater streams (Waters, 2000). Juday Creek does not necessarily fit the profile of a coldwater stream. Darters, creek chub, and green sunfish, for example, are eurythermic (adapted to broad range in temperature) and have been documented throughout the stream. White crappie, smallmouth bass, and white sucker have also been documented within the stream. These species are normally associated with warmer water. Since the fish community does not strictly adhere to that of a coldwater stream and because no index exists to determine biotic integrity in coldwater streams, Simon's (1997) IBI for use in warmwater streams of the Northern Indiana Till Plain Ecoregion of Indiana was used. Due to the implications mentioned, IBI scores included in this survey may not reflect the actual biotic integrity of the stream but do form baseline data from which future studies can be compared.

Macroinvertebrate Sampling Methods

Macroinvertebrate samples from each of the two sites were used to calculate a family-level Hilsenhoff Biotic Index (FBI) (Hilsenhoff, 1988) and a macroinvertebrate Index of Biotic Integrity (mIBI) (IDEM, 1996). Aquatic macroinvertebrates are important indicators of environmental change. The insect community composition reflects water quality, and research shows that different macroinvertebrate orders and families react differently to pollution sources. Indices of biotic integrity are valuable because aquatic biota integrate cumulative effects of sediment and nutrient pollution (Ohio EPA, 1999).

Macroinvertebrates were collected on October 19, 2001 using the multihabitat approach detailed in the USEPA Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers, 2nd edition (Barbour et al., 1999). Kick nets were utilized to sample available habitat types. Greater than 100 organisms were obtained from each site and preserved in 70% isopropyl alcohol for later identification at the J.F. New laboratory. All equipment was carefully examined and rinsed for any remaining organisms prior to leaving the site.

In the laboratory the sample was evenly spread into a pan of 1,925 cm^2 in discreet 5 cm x 5 cm quadrats numbered 1-77 (IDEM, 1996). Organisms in random squares were counted and sorted. Sorting continued until all organisms had been removed from the last quadrat necessary to obtain 100 organisms. Sorted organisms were identified to the family level, and IDEM datasheets were filled out for each sampling event. The family-level approach was used: 1) to collect data comparable to that collected by IDEM in the state; 2) because it allows for increased organism identification accuracy; 3) because several studies support the adequacy of family-level analysis

(Furse et al. 1984, Hilsenhoff 1988, Ferraro and Cole 1995, Marchant 1995, Bowman and Bailey 1997, Waite et al. 2000).

Macroinvertebrate data were used to calculate the family-level Hilsenhoff Biotic Index (FBI). Calculation of the FBI involves applying assigned macroinvertebrate family tolerance values to all taxa present that have an assigned FBI tolerance value, multiplying the number of organisms present by their family tolerance value, summing the products, and dividing by the total number of organisms present (Hilsenhoff, 1988). Organisms of greater tolerance to pollution or disturbance were assigned a greater value from 1-9; therefore, a higher value on the FBI scale indicates greater impairment.

In addition to the FBI, macroinvertebrate results were analyzed by applying the IDEM mIBI (IDEM, 1996). mIBI scores allow comparison with data compiled by IDEM for wadeable riffle-pool streams in Indiana. Table 1 lists the ten scoring metrics with classification scores of 0-8. The mean of the ten metrics is the mIBI score. mIBI scores of 0-2 indicate the sampling site is severely impaired; scores of 2-4 indicate the site is moderately impaired, scores of 4-6 indicate the site is slightly impaired, and scores of 6-8 indicate that the site is non-impaired. IDEM developed the classification criteria based on five years of wadeable riffle-pool data collected in Indiana. All ten of the metrics were used for the mIBI calculation in this study: family-level HBI, number of taxa, number of individuals, percent dominant taxa, EPT Index, EPT count, EPT count to total number of individuals, EPT count to chironomid count, chironomid count, and total number of individuals to number of square sorted. (EPT stands for individuals of the Ephemeroptera, Plecoptera, and Trichoptera Orders.)

TABLE 1. Benthic macroinvertebrate scoring metrics and classification scores used by IDEM in evaluation of riffle-pool streams in Indiana.

	SCORING CRITERIA FOR THE FAMILY LEVEL MACROINVERTEBRATE INDEX OF BIOTIC INTEGRITY (mIBI) USING PENTASECTION AND CENTRAL TENDENCY ON THE LOGARITHMIC TRANSFORMED DATA DISTRIBUTIONS OF THE 1990-1995 RIFFLE KICK SAMPLES				
		CLASSIFICATION SCORE			
	0	2	4	6	8
Family Level FBI	≥ 5.63	5.62- 5.06	5.05-4.55	4.54-4.09	≤ 4.08
Number of Taxa	≤ 7	8-10	11-14	15-17	≥ 18
Number of Individuals	≤ 79	129-80	212-130	349-213	≥ 350
Percent Dominant					

Taxa	≥ 61.6	61.5-43.9	43.8-31.2	31.1-22.2	≤ 22.1
EPT Index	≤ 2	3	4-5	6-7	≥ 8
EPT Count	≤19	20-42	43-91	92-194	≥ 195
EPT Count To Total Number of Individuals	≤ 0.13	0.14-0.29	0.30-0.46	0.47-0.68	≥ 0.69
EPT Count To Chironomid Count	≤ 0.88	0.89-2.55	2.56-5.70	5.71-11.65	≥ 11.66
Chironomid Count	≥ 147	146-55	54-20	19-7	≤ 6
Total Number of Individuals To Number of Squares Sorted	≤ 29	30-71	72-171	172-409	≥ 410

Where 0-2 = Severely Impaired; 2-4 = Moderately Impaired; 4-6 = Slightly Impaired; 6-8 = Non-impaired

Habitat Sampling Methods

On October 19, 2001, a vegetation survey was conducted and physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995). The QHEI is a physical habitat index designed to provide empirical, quantified evaluation of the general lotic macrohabitat characteristics that are important to warmwater faunas (OEPA, 1989). It is composed of six metrics including substrate composition, in-stream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle-run quality, and map gradient. Each metric is scored individually then summed to provide the total QHEI score. The best possible score is 100.

The QHEI is used to evaluate the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of stream segments in Ohio have indicated that values greater than 60 are *generally* conducive to the existence of warmwater faunas. Scores greater than 75 typify habitat conditions that have the ability to support exceptional warmwater faunas (Ohio EPA, 1999).

RESULTS

Fish

A total of 124 fish representing six families and ten species was collected from Juday 1 during the October 2001 sampling (Table 2) (See Attachment 1 for complete electrofishing data). Creek chub (*Semotilus atromaculatus*) dominated the catch at 52% of the total. Central stoneroller (*Campostoma anomalum*), mottled sculpin (*Cottus bairdi*), and johnny darter (*Etheostoma*

nigrum) were also important components of the fish community at 21%, 6.5%, and 6.5% respectively. The minnow family (Cyprinidae) comprised 78% of the total sample followed by the sculpin family (Cottidae) (6.5%) and perch family (Percidae) (6.5%). Of the 124 fish collected, 79 (64%) were highly tolerant while 3 (2.5%) were highly intolerant (sensitive). No state or federally listed endangered species were collected at Juday 1.

TABLE 2. Fish species documented from October 2001 electrofishing surveys

Common name	Scientific name	Juday 1	Length Range (mm)	Juday 2	Length Range (mm)
Creek chub	*Semotilus atromaculatus*	64	50-240		
Blacknose dace	*Rhinichthys atratulus*	7	40-95		
Trout sp. (Juvenile)	*N/A*	1	95	3	110-165
Green sunfish	*Lepomis cyanellus*	4	50-120		
Central stoneroller	*Campostoma anomalun*	26	62-100	4	75-98
White sucker	*Catostomus commersoni*	4	170-345	3	150-290
Mottled sculpin	*Cottus bairdi*	8	45-70	134	45-115
Rock bass	*Ambloplites rupestris*	1	80		
Johnny darter	*Etheostoma nigrum*	8	25-50		
Brown trout	*Salmo trutta*	1	27 inches		
Central mudminnow	*Umbra limi*			21	52-120
Bluegill	*Lepomis machrochirus*			4	30-50
TOTALS	**Individuals**	**124**		**169**	
	Families	**6**		**6**	
	Species	**10**		**6**	

A fish community different to that at Juday 1 was sampled at Juday 2. A total of 169 fish representing six families and ten species was collected from Juday 2 (Table 2). Mottled sculpin dominated the catch with 79% of the total. Central mudminnow (*Umbra limi*) was also an important component of the fish community comprising 12% of the catch. The sculpin family (Cottidae) comprised 79% of the total sample followed by the mudminnow family (Umbridae) with 12%. Of the 169 fish collected, 25 (14%) were highly tolerant while 3 (2%) were intolerant (sensitive). No state or federally endangered species were collected at Juday 2.

IBI scores for each sampling site are given in Table 3 while Table 4 displays the Index of Biotic Integrity classification summary (See Attachment 2 for complete IBI calculation). IBI values ranged from a low of 30 (Poor) at Juday 1 to a high of 42 (Fair) at Juday 2. No scores fell between 48 (Good) and 60 (Excellent) or below 22 (Very Poor-No Fish). Poor quality fish communities like those seen at Juday 1 are typically dominated by omnivores, tolerant forms and habitat generalists. Usually few top predators exist, and growth rates and condition factors are depressed (Simon, 1997). Juday 2 consisted of a fair quality fish community. Fair quality fish communities typically show signs of deterioration including loss of intolerant forms and species richness somewhat below expectations (Simon, 1997).

TABLE 3. Metric values and stream characterization by site using the Index of Biotic Integrity. Separate expectations are developed for Headwater stream sites (drainage areas <20 mile^2) and wadable rivers (drainage areas >20 miles^2).

Metric	Juday 1 27.1 miles^2 drainage	Score	Juday 2 13.5 miles^2 drainage	Score
Number of species	10	3	6	3
Number of darter/madtom/sculpin sp.	-	-	1	1
Number of darter species	1	1	-	-
Percent headwater species	-	-	79	5
Number of sunfish species	2	3	-	-
Number of minnow species	-	-	1	1
Number of sucker species	1	1	-	-
Number of sensitive species	3	3	1	1
Percent tolerant individuals	64	3	14	5
Percent omnivore individuals	3	5	14	5
Percent insectivorous individuals	16	1	82	5
Percent pioneer species	-	-	2.4	5
Percent carnivorous individuals	2.4	1	-	-
Catch per unit effort	124	3	169	5
Percent simple lithophilic individuals	9	1	2	1
Percent DELT individuals	0	5	0	5
IBI		**30**		**42**
Integrity Class		**Poor**		**Fair**

TABLE 4. Attributes of Index of Biotic Integrity classification.

IBI	Integrity Class	Attributes
58-60	Excellent	Comparable to the best situation without human disturbance.
48-52	Good	Species richness somewhat below expectations.
40-44	Fair	Signs of additional deterioration include loss of intolerant forms.
28-34	Poor	Dominated by omnivores, tolerant forms, and habitat generalists.
12-22	Very Poor	Few fish present. Mostly introduced or tolerant forms.
0	No Fish	Repeat sampling finds no fish.

Source: Development of Index of Biotic Integrity Expectations for the Ecoregions of Indiana III. Northern Indiana Till Plain (Simon, 1997).

Lack of darter and sucker species, small proportion of carnivorous individuals, and low numbers of lithophilic spawners negatively affected the IBI score (30) at Juday 1. Lack of darter species and simple lithophilic spawners indicate that clean gravel or cobble substrates are lacking. Sucker species represent a major component of the Indiana fish fauna and most are intolerant to habitat and water quality degradation (Phillips and Urderhil 1971; Karr et al. 1986; Trautman 1981; Becker 1983). White sucker, a tolerant species, was the only sucker species documented at Juday 1. The proportion of carnivores in a system measures the community integrity in the upper trophic levels of the fish community. It is only in high quality environments that upper

trophic levels are able to flourish (Simon, 1997). A low percentage of carnivores at Juday 1 are indicative of a system lacking a sustained upper trophic level of the fish community.

A fish community different to that at Juday 1 was sampled at Juday 2. Lack of darter/madtom/sculpin (DMS), minnow, and sensitive species, and low proportion of lithophilic spawners lowered the IBI score at Juday 2. Lack of DMS species and simple lithophilic spawners indicates that clean gravel or cobble substrates were minimal. The number of minnow species generally correlates with increased environmental quality (Simon, 1997). Many members of this group found together generally represent a wide variety of biological integrity. The lack of minnow species at Juday 2 suggests decreased environmental quality. Sensitive species typically comprise 5-10% of common species sampled in Indiana (Simon, 1997). Three individuals representing one sensitive species comprised only 2% of the total sample. This is suggestive of water quality conditions not suitable for pollution intolerant forms.

Macroinvertebrates

FBI scores for each sampling site are given in Table 5 while Table 6 correlates the FBI with water quality and degree of organic pollution. By this measure, Juday 1 ranked as "Fair" and Juday 2 as "Very Good" in October, 2001. A "Fair" score indicated that fairly substantial pollution was likely while "Very Good" indicated that possible slight organic pollution was present.

TABLE 5. Family-level Hilsenhoff Biotic Index at Juday 1 and 2.

Site	FBI
Juday 1	5.29
Juday 2	4.18

TABLE 6. Water Quality Correlation to family-level Hilsenhoff Biotic Index

Family Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very poor	Severe organic pollution likely

Source: Rapid field assessment of organic pollution with a family-level biotic index (Hilsenhoff, 1988)

mIBI scores for each sampling site are given in Table 7. Detailed mIBI results and bench sheets are included in Attachment 3. The mIBI scores ranged from 4.0 at Juday 1 to 4.2 at Juday 2. The score at Juday 1 indicated slight to moderate impairment while Juday 2 was classified as slightly impaired.

TABLE 7. Classification scores and mIBI score for sampling sites in Juday Creek in October, 2001

	Juday 1	Juday 2
HBI	2	6
Number of Taxa (families)	2	2
Number of Individuals	2	2
% Dominant Taxa	4	2
EPT Index	4	4
EPT Count	4	4
EPT Count/Total Count	6	6
EPT Count/Chironomid Count	8	8
Chironomid Count	8	8
Total Count/Number Squares Sorted	0	0
mIBI Score	**4.0**	**4.2**

Table 8 presents the total number of macroinvertebrate individuals and families collected at each of the two sites sampled during October 2001 (See Attachment 4 for complete collection data). Both sites exhibited similar community types. In general, organisms collected have been assigned moderate tolerance values, and more intolerant individuals were collected than tolerant.

TABLE 8. Macroinvertebrate families collected during the October sampling events

Order	Family	Juday 1	Juday 2
COLEOPTERA			
	Elmidae	11	7
DIPTERA			
	Chironomidae	4	4
	Simuliidae	11	-
EPHEMEROPTERA			
	Baetidae	-	5
	Heptageniidae	6	2
PLECOPTERA			
	Nemouridae	-	1
TRICOPTERA			
	Hydropsychidae	40	60
	Leptoceridae	2	-
AMPHIPODA			
	Gammaridae	2	13
	Asellidae	-	2
GASTROPODA			
	Physa	6	5
	Amnicola	-	1
PELECYPODA			
	Sphaeriidae	19	-
TOTALS	**Individuals**	**101**	**100**
	Families	**9**	**10**

mIBI scores at Juday 1 were lowered by small values measured for the FBI, number of taxa, number of individuals, and total count/number of squares sorted. However, a large proportion of individuals belonging to the Ephemeroptera, Plecoptera, and Trichoptera (EPT) orders were collected. Organisms belonging to these three orders are typically pollution intolerant and indicate conditions of higher quality. The presence of these species raised values measured for EPT count/total count and EPT count/chironomid count. Additionally, a low proportion of chironomids resulted in a high chironomid count score.

A macroinvertebrate community similar to that at Juday 1 was also sampled at Juday 2. mIBI scores at Juday 2 were lowered by small values measured for the number of taxa, number of individuals, percent dominant taxa, and total count/number of squares sorted. A large number of individuals belonging to EPT orders were present. These pollution intolerant orders supported the high EPT count/total count and EPT count/chironomid count. Additionally, few chironomids were sampled resulting in a high chironomid count score.

Habitat

A habitat analysis and vegetation survey was conducted at each sample site. QHEI scores are listed in Table 9 for each sampling site (See Attachment 5 for QHEI calculation data and Attachment 6 for vegetation survey). Scores ranged from a high of 57.5 at Juday 1 to a low of 38.5 at Juday 2. Both scores were lower than the minimum score of 60 found by the Ohio EPA to be conducive to aquatic life support in Ohio streams. A below average riparian zone and poor riffle-pool-run development lowered the QHEI score at Juday 1. Poor substrate, channel morphology, and riparian zone scores greatly reduced the QHEI score at Juday 2.

TABLE 9. QHEI scores for sampling sites on Juday Creek

Site	Substrate Score	Cover Score	Channel Score	Riparian Score	Pool Score	Riffle Score	Gradient Score	Total Score
Juday 1	14	10	10	5.5	6	4	8	57.5
Juday 2	1	9	5	2.5	6	5	10	38.5

Discussion

On October 19, 2001 J.F. New conducted a survey of biological and habitat integrity downstream of several proposed project sites. Baseline data collected from fish, macroinvertebrate, and habitat surveys were established for future monitoring after construction of best management practices to allow for scientific studies of improvements in the stream.

Fish communities differed at Juday 1 and Juday 2. The IBI revealed that a "Poor" quality fish community exists at Juday 1 while Juday 2 supports a "Fair" quality fish community. Poor quality fish communities are typically dominated by omnivores, tolerant forms and habitat generalists. Usually few top predators exist, and growth rates and condition factors are depressed (Simon, 1997). Fair quality fish communities typically show signs of deterioration including loss of intolerant forms and species richness somewhat below expectations (Simon, 1997). In general, development of the watershed and modifications to the original stream channel most likely inhibit Juday Creek from supporting "Good" to "Excellent" quality fish communities.

Macroinvertebrate communities were similar at Juday 1 and 2. The HBI ranked Juday 1 as "Fair" and Juday 2 as "Very Good" in terms of organic pollution present. A "Fair" score indicated that fairly substantial pollution was likely while "Very Good" indicated that possible slight organic pollution was present. According to the mIBI score at Juday 1, slight to moderate impaired was present while Juday 2 was moderately impaired. Pollutants from the surrounding watershed and lack of quality habitat most likely reduced the number of intolerant organisms able to survive in Juday Creek.

QHEI scores at Juday 1 and 2 were lower than the minimum score of 60 found by the Ohio EPA to be conducive to aquatic life support in Ohio streams. A below average riparian zone and poor riffle-pool-run development lowered the QHEI score at Juday 1. Poor substrate, channel morphology, and riparian zone scores greatly reduced the QHEI score at Juday 2. These degraded conditions as well as pollutants from the surrounding watershed likely reduced the quality of both fish and macroinvertebrate communities in Juday Creek.

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ATTACHMENT I

FISH DATA SHEETS

BIOLOGICAL/HABITAT ASSESSMENT REPORT:
JUDAY CREEK
ST. JOSEPH COUNTY, INDIANA

Page 1 of 1

J.F. New & Associates, Inc.
Aquatics Division
[SH POPULATION ANALYSIS
lition factor & Length-Frequency Summary)

STREAM/LOCATION Juday Creek 1

PROJECT # 00-01-12

COLLECTION DATE: 10-19-01

SPECIES mmon name or code)	NUMBER	LENGTH or RANGE (mm)	WEIGHT (grams)	DISEASE	COMMENTS
eek chub	64	50-240			
acknose dace	7	40-95			
rout sp.	1	95			
reen sunfish	4	50-120			
tral stoneroller	26	62-100			
ite sucker	4	170-345			
tled sculpin	8	45-70			
k bass	1	80			
nmy darter	8	25-50			
ow trout	1	27 inches			
	124				

ber of Species: 10 Sampling Time Involved: 28.2 (min) Method of Collection: Backpack

ɔgist(s): Steve Zimmerman Date of Report: 10-19-01

Page 1 of 1

J.F. New & Associates, Inc.
Aquatics Division
SH POPULATION ANALYSIS
lition factor & Length-Frequency Summary)

STREAM/LOCATION Tuday Creek 2

PROJECT # 00-01-12

COLLECTION DATE: 10-19-01

SPECIES (mmon name or code)	NUMBER	LENGTH or RANGE (mm)	WEIGHT (grams)	DISEASE	COMMENTS
Trout sp.	3	110-165			
Hod sculpin	134	45-115			
ntral mudminnow	21	52-120			
ite sucker	3	150-290			
ntral Stoneroller	4	75-98			
egill	4	30-50			
	169				

ber of Species: 6 Sampling Time Involved: 19.5 (min) Method of Collection: Backpack

ɔgist(s): Steve Zimmerman Date of Report: 10-19-01

ATTACHMENT 2

IBI DATA SHEETS

BIOLOGICAL/HABITAT ASSESSMENT REPORT:
JUDAY CREEK
ST. JOSEPH COUNTY, INDIANA

J.F. New & Associates, Inc.
Aquatics Division

IBI CALCULATION

(> 20 - < 1000 miles^2 drainage area)
Northern Indiana Till Plains

STREAM/LOCATION: Judy Creek 1

DRAINAGE & AREA (mile^2): GIS Model = 27.1

PROJECT #: 00-01-12

COLLECTION DATE: 10-19-01

Metric	# or %	Score
# of Species	10	3
# of Darter sp.	1	1
# of Sunfish sp.	2	3
# of Sucker sp.	1	1
# of Sensitive sp.	3	3
% Tolerant Individuals	64	3
% Omnivore Individuals	3	5
% Insectivores Individuals	16	1
% Carnivores Individuals	2.4	1
Catch per Unit Effort	124	3
% Simple Lithophils Individuals	9	1
% DELT Individuals	0	5

Sample Distance (ft or m)	380
Sample Time (sec or min)	28.2
IBI Score	30
Integrity Class	Poor

J.F. New & Associates, Inc.
Aquatics Division

IBI CALCULATION

(< 20 miles^2 drainage (Headwater Stream))
Northern Indiana Till Plains

STREAM/LOCATION: Juday Cr. 2

DRAINAGE AREA (mile^2): GIS Model = 13.5

PROJECT #: 00-012

COLLECTION DATE: 10-19-01

Metric	# or %	Score
# of Species	6	3
# of DMS sp.	1	1
% Headwater sp.	79	5
# Minnow sp.	1	1
# of Sensitive sp.	1	1
% Tolerant Individuals	14	5
% Omnivore Individuals	14	5
% Insectivores Individuals	82	5
% Pioneer sp.	2.4	5
Catch per Unit Effort	169	5
% Simple Lithophils Individuals	1.8	1
% DELT Individuals	0	5

Sample Distance (ft or m)	320
Sample Time (sec or min)	19.5
Sample Method	Backpack
IBI Score	42
Integrity Class	Fair

ATTACHMENT 3

MACROINVERTEBRATE BENCH SHEETS

BIOLOGICAL/HABITAT ASSESSMENT REPORT:
JUDAY CREEK
ST. JOSEPH COUNTY, INDIANA

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OWM - BIOLOGICAL STUDIES
BENTHIC MACROINVERTEBRATE BENCH SHEET
PHASE 1 TAXONOMY

SAMPLE NUMBER: Judy1 ____ SITE: Judy Cr. Inglewood Douglas COUNTY: St. Joseph CREW CHIEF: S.Z
LOCATION: HYDROLOGIC UNIT: DATE OF COLLECTION: 10-19-01
ECOREGION: NITP IASNRI: SORTER: S.Z. LABEL CHECK:____

EPHEMEROPTERA
SIPHLONURIDAE (7) ____ METRETOPODIDAE (2) ____ BAETIDAE (4) ____ BAETISCIDAE (3) ____ HEPTAGENIIDAE (4) 6
EPHEMERELLIDAE (1) ____ TRICORYTHIDAE (4) ____ CAENIDAE (7) ____ OLIGONEURIIDAE (2) ____ LEPTOPHLEBIIDAE (2) ____
POTAMANTHIDAE (4) ____ EPHEMERIDAE (4) ____ POLYMITARCYIDAE (2) ____

ODONATA ZYGOPTERA
CORDULEGASTRIDAE (3) ____ GOMPHIDAE (1) ____ AESHNIDAE (3) ____ MACROMIIDAE (3) ____ CORDULIIDAE (3) ____
LIBELLULIDAE (9) ____ CALOPTERYGIDAE (5) ____ LESTIDAE (9) ____ COENAGRIONIDAE (9) ____

PLECOPTERA
PTERONARCYIDAE (0) ____ TAENIOPTERYGIDAE (2) ____ NEMOURIDAE (2) ____ LEUCTRIDAE (0) ____ CAPNIIDAE (1) ____
PERLIDAE (1) ____ PERLODIDAE (2) ____ CHLOROPERLIDAE (1) ____

HEMIPTERA
MACROVELIIDAE ( ) ____ VELIIDAE ( ) ____ GERRIDAE ( ) ____ BELOSTOMATIDAE ( ) ____ NEPIDAE ( ) ____ CORIXIDAE ( ) ____
NOTONECTIDAE ( ) ____ PLEIDAE ( ) ____ SALDIDAE ( ) ____ HEBRIDAE ( ) ____ NAUCORIDAE ( ) ____ MESOVELIIDAE ( ) ____

MEGALOPTERA SIALIDAE (4) ____ CORYDALIDAE (1) ____ SISYRIDAE ( ) ____

TRICHOPTERA
PHILOPOTAMIDAE (3) ____ PSYCHOMYIIDAE (2) ____ POLYCENTROPODIDAE (6) ____ HYDROPSYCHIDAE (4) 40
RHYACOPHILIDAE (0) ____ GLOSSOSOMATIDAE (0) ____ HYDROPTILIDAE (4) ____ PHRYGANEIDAE (4) ____
BRACHYCENTRIDAE (1) ____ LEPIDOSTOMATIDAE (1) ____ HELICOPSYCHIDAE (3) ____ SERICOSTOMATIDAE (3) ____
ODONTOCERIDAE (0) ____ MOLANNIDAE (6) ____ LIMNEPHILIDAE (4) ____ LEPTOCERIDAE (4) 2

LEPIDOPTERA PYRALIDAE (5) ____ NOCTUIDAE ( ) ____

COLEOPTERA
GYRINIDAE( ) ____ HALIPLIDAE( ) ____ DYTISCIDAE( ) ____ HYDROPHILIDAE( ) ____ PSEPHENIDAE (4) ____ DRYOPIDAE(5) ____ ELMIDAE(4) 11
CURCULIONIDAE ( ) ____ STAPHYLINIDAE ( ) ____ CHRYSOMELIDAE ( ) ____ CURCULIONIDAE ( ) ____ HYDRAENIDAE ( ) ____

DIPTERA
BLEPHARICERIDAE (0) ____ TIPULIDAE (3) ____ PSYCHODIDAE (10) ____ TABANIDAE (6) ____ ATHERICIDAE (2) ____
CHIRONOMIDAE(blood red)(8) ____ CHIRONOMIDAE(all other)(6) 4 SYRPHIDAE (10) ____ EPHYDRIDAE (6) ____ MUSCIDAE (6) ____
DOLICHOPODIDAE (4) ____ EMPIDIDAE (6) ____ CERATOPOGONIDAE (6) ____ SIMULIIDAE (6) 11 CHAOBORIDAE ( ) ____

COLLEMBOLA ISOTOMIDAE ( ) ____ PODURIDAE ( ) ____ SMINTHURIDAE ( ) ____ ENTOMOBRYIDAE ( ) ____

OTHER ARTHROPODA
ACARI (4) ____ ASELLIDAE (8) ____ GAMMARIDAE (4) 2 TALITRIDAE (8) ____ ASTACIDAE (6) ____

MOLLUSCA
GASTROPODA FERRISSIA (6) ____ HELISOMA (6) ____ LYMNAEA (6) ____ AMNICOLA (8) ____ PLEUROCERIDAE ( ) ____ VIVIPARIDAE ( ) ____
BITHYNIA (8) ____ GYRAULUS (8) ____ PHYSA (8) 6 PLANORBIDAE ( ) ____ HYDROBIIDAE ( ) ____ ANCYLIDAE ( ) ____
PELECYPODA SPHAERIIDAE (8) 19 CORBICULA ( ) ____ DREISSENIA ( ) ____

PLATYHELMINTHES TURBELLARIA (4) ____ ANNELIDA ( ) ____ OLIGOCHAETA ( ) ____ TUBIFICIDAE ( ) ____ NAIDIDAE ( ) ____
HIRUDINEA ( ) ____ HELOBDELLA (10) ____ BRANCHIOBDELLIDA ( ) ____ ERPOBDELLIDAE ( ) ____ NEMATODA ( ) ____

NUMBER OF VIALS FORWARDED:____ PRELIMINARY NUMBER OF TAXA: 10 NUMBER OF INDIVIDUALS: 101

MBI: 5.29 EPT COUNT: 48 EPT ABUN./CHIR. ABUN.: 12 CHIRONOMID COUNT: 4
DOMINANT TAXON: 39.6 EPT INDEX: 4 EPT/TOTAL COUNT: 47.5 #/square 3.9 MIBI = 40/10 = 4.0
PHASE 1 IDENTIFICATION COMPLETED BY: S.Z. DATE COMPLETED: 10-22-01 COUNTS & CALCULATION CHECK:____ ____

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OWM - BIOLOGICAL STUDIES
BENTHIC MACROINVERTEBRATE BENCH SHEET
PHASE 1 TAXONOMY

SAMPLE NUMBER: Juday2 SITE: Juday Cr. E. of Capital COUNTY: St. Joseph CREW CHIEF: S.Z.
LOCATION: HYDROLOGIC UNIT: DATE OF COLLECTION: 10-19-01
ECOREGION: NITP IASNRI: SORTER: S.Z. LABEL CHECK:

EPHEMEROPTERA
SIPHLONURIDAE (7) ___ METRETOPODIDAE (2) ___ BAETIDAE (4) 5 BAETISCIDAE (3) ___ HEPTAGENIIDAE (4) 2
EPHEMERELLIDAE (1) ___ TRICORYTHIDAE (4) ___ CAENIDAE (7) ___ OLIGONEURIIDAE (2) ___ LEPTOPHLEBIIDAE (2) ___
POTAMANTHIDAE (4) ___ EPHEMERIDAE (4) ___ POLYMITARCYIDAE (2) ___

ODONATA ZYGOPTERA
CORDULEGASTRIDAE (3) ___ GOMPHIDAE (1) ___ AESHNIDAE (3) ___ MACROMIIDAE (3) ___ CORDULIIDAE (3) ___
LIBELLULIDAE (9) ___ CALOPTERYGIDAE (5) ___ LESTIDAE (9) ___ COENAGRIONIDAE (9) ___

PLECOPTERA
PTERONARCYIDAE (0) ___ TAENIOPTERYGIDAE (2) ___ NEMOURIDAE (2) 1 LEUCTRIDAE (0) ___ CAPNIIDAE (1) ___
PERLIDAE (1) ___ PERLODIDAE (2) ___ CHLOROPERLIDAE (1) ___

HEMIPTERA
MACROVELIIDAE ( ) ___ VELIIDAE ( ) ___ GERRIDAE ( ) ___ BELOSTOMATIDAE ( ) ___ NEPIDAE ( ) ___ CORIXIDAE ( ) ___
NOTONECTIDAE ( ) ___ PLEIDAE ( ) ___ SALDIDAE ( ) ___ HEBRIDAE ( ) ___ NAUCORIDAE ( ) ___ MESOVELIIDAE ( ) ___

MEGALOPTERA SIALIDAE (4) ___ CORYDALIDAE (1) ___ SISYRIDAE ( ) ___

TRICHOPTERA
PHILOPOTAMIDAE (3) ___ PSYCHOMYIIDAE (2) ___ POLYCENTROPODIDAE (6) ___ HYDROPSYCHIDAE (4) 60
RHYACOPHILIDAE (0) ___ GLOSSOSOMATIDAE (0) ___ HYDROPTILIDAE (4) ___ PHRYGANEIDAE (4) ___
BRACHYCENTRIDAE (1) ___ LEPIDOSTOMATIDAE (1) ___ HELICOPSYCHIDAE (3) ___ SERICOSTOMATIDAE (3) ___
ODONTOCERIDAE (0) ___ MOLANNIDAE (6) ___ LIMNEPHILIDAE (4) ___ LEPTOCERIDAE (4) ___

LEPIDOPTERA PYRALIDAE (5) ___ NOCTUIDAE ( ) ___

COLEOPTERA
PTYRINIDAE( ) ___ HALIPLIDAE( ) ___ DYTISCIDAE( ) ___ HYDROPHILIDAE( ) ___ PSEPHENIDAE (4) ___ DRYOPIDAE(5) ___ ELMIDAE(4) 7
SCIRTIDAE ( ) ___ STAPHYLINIDAE ( ) ___ CHRYSOMELIDAE ( ) ___ CURCULIONIDAE ( ) ___ HYDRAENIDAE ( ) ___

DIPTERA
BLEPHARICERIDAE (0) ___ TIPULIDAE (3) ___ PSYCHODIDAE (10) ___ TABANIDAE (6) ___ ATHERICIDAE (2) ___
CHIRONOMIDAE(blood red)(8) ___ CHIRONOMIDAE(all other)(6) 4 SYRPHIDAE (10) ___ EPHYDRIDAE (6) ___ MUSCIDAE (6) ___
DOLICHOPODIDAE (4) ___ EMPIDIDAE (6) ___ CERATOPOGONIDAE (6) ___ SIMULIIDAE (6) ___ CHAOBORIDAE ( ) ___

COLLEMBOLA ISOTOMIDAE ( ) ___ PODURIDAE ( ) ___ SMINTHURIDAE ( ) ___ ENTOMOBRYIDAE ( ) ___

OTHER ARTHROPODA
ACARI (4) ___ ASELLIDAE (8) 2 GAMMARIDAE (4) 13 TALITRIDAE (8) ___ ASTACIDAE (6) ___

MOLLUSCA
GASTROPODA FERRISSIA (6) ___ HELISOMA (6) ___ LYMNAEA (6) ___ AMNICOLA (8) 1 PLEUROCERIDAE ( ) ___ VIVIPARIDAE ( ) ___
BITHYNIA (8) ___ GYRAULUS (8) ___ PHYSA (8) 5 PLANORBIDAE ( ) ___ HYDROBIIDAE ( ) ___ ANCYLIDAE ( ) ___
PELECYPODA SPHAERIIDAE (8) ___ CORBICULA ( ) ___ DREISSENIA ( ) ___

PLATYHELMINTHES TURBELLARIA (4) ___ ANNELIDA ( ) ___ OLIGOCHAETA ( ) ___ TUBIFICIDAE ( ) ___ NAIDIDAE ( ) ___
HIRUDINEA ( ) ___ HELOBDELLA (10) ___ BRANCHIOBDELLIDA ( ) ___ ERPOBDELLIDAE ( ) ___ NEMATODA ( ) ___

NUMBER OF VIALS FORWARDED: ___ PRELIMINARY NUMBER OF TAXA: 10 NUMBER OF INDIVIDUALS: 100

BI: 4.18 EPT COUNT: 68 EPT ABUN./CHIR. ABUN.: 17 CHIRONOMID COUNT: 4 #/square 9.09 mIBI = 42

DOMINANT TAXON: 60 EPT INDEX: 3.97 EPT/TOTAL COUNT: 68 or 4.2

PHASE 1 IDENTIFICATION COMPLETED BY: S.Z. DATE COMPLETED: 10-23-01 COUNTS & CALCULATION CHECK: ___ ___

ATTACHMENT 4

MACROINVERTEBRATE DATA SHEETS

BIOLOGICAL/HABITAT ASSESSMENT REPORT:
JUDAY CREEK
ST. JOSEPH COUNTY, INDIANA

Page 1 of 1

J.F. New & Associates, Inc.
Aquatics Division
MACROINVERTEBRATE POPULATION ANALYSIS
(Identification & Scoring Criteria Summary)

STREAM/LAKE: Juday Cr 1

STATION: _____

COLLECTION DATE: 10-19-01

FAMILY	GENUS	SPECIES	NUMBER	SCORE	COMMENTS
ydropsychidae			40		
ptagenidae			6		
nulidae			11		
	Gammarus		2		
~~ptagenidae~~			~~6~~		
ricorythidae			4		
pioceridae			2		
nidae			11		
	Physa		6		
haeridae	Pea clam		2		
idae	Pisidium		17		
			101		

al Number of Species: 11 Score: _____

ıpling Time Involved: — (min) Method of Collection: 1m² Kicknet

logist(s): Steve Zimmerman Date of Report: 10-22-01

Page 1 of 1

J.F. New & Associates, Inc.
Aquatics Division
ACROINVERTEBRATE POPULATION ANALYSIS
(Identification & Scoring Criteria Summary)

STREAM/LAKE: Tuday Cr. 2

STATION: _____

COLLECTION DATE: 10-19-01

FAMILY	GENUS	SPECIES	NUMBER	SCORE	COMMENTS
ydropsychidae			60		
	Physa		5		
	Amnicola		1		
hironomidae			4		
Imidae			7		
	Gammarus		13		
ordians			5		
	Asellus		2		
etageridae			2		
'smouridae			1		
			100		

al Number of Species: 10 Score: _____

npling Time Involved: — (min) Method of Collection: Kicknet (1m²)

logist(s): S.Z. Date of Report: 10-23-01

ATTACHMENT 5

QHEI DATA SHEETS

BIOLOGICAL/HABITAT ASSESSMENT REPORT:
JUDAY CREEK
ST. JOSEPH COUNTY, INDIANA

REAM: Indy Creek 1 RIVER MILE _____ DATE: 10-19-01 QHEI SCORE 57.5

UBSTRATE: (Check ONLY Two Substrate Type Boxes: Check all types present) SUBSTRATE SCORE 14

	POOL	RIFFLE			POOL	RIFFLE
BLDER/SLAB(10)			✓	GRAVEL(7)	✓	✓
BOULDER(9)			✓	SAND(6)	✓	✓
COBBLE(8)				BEDROCK(5)		
HARDPAN(4)				DETRITUS(3)		
MUCK/SILT(2)	✓	✓		ARTIFIC(0)		

SUBSTRATE ORIGIN (all): LIMESTONE(1), RIP/RAP(0), ✓TILLS(1), HARDPAN(0), SANDSTONE(0), SHALE(-1), COAL FINES(-2)

SILT COVER (one): SILT-HEAVY(-2), SILT-MOD(-1), ✓SILT-NORM(0), SILT-FREE(1)

Extent of Embeddedness (check one): EXTENSIVE(-2), MODERATE(-1), ✓LOW(0), NONE(1)

L NUMBER OF SUBSTRATE TYPES: >4(2) ✓4 <4(0)

: (Ignore sludge that originates from point sources; score is based on natural substrates)

MMENTS: _____

ISTREAM COVER: COVER SCORE 10

TYPE (Check all that apply): NDERCUT BANKS(1), /ERHANGING VEGETATION(1), IALLOWS (IN SLOW WATER)(1), DEEP POOLS(2), ✓ROOTWADS(1), BOULDERS(1), OXBOWS(1), AQUATIC MACROPHYTES(1), ✓LOGS OR WOODY DEBRIS(1)

AMOUNT (Check only one or Check 2 and AVERAGE): EXTENSIVE >75%(11), ✓MODERATE 25-75%(7), SPARSE 5-25%(3), NEARLY ABSENT <5%(1)

MMENTS: _____

HANNEL MORPHOLOGY: (Check ONLY ONE per Category or Check 2 and AVERAGE) CHANNEL SCORE 10

OSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	MODIFICATION/OTHER
GH(4)	EXCELLENT(7)	NONE(6)	HIGH(3)	✓SNAGGING
DERATE(3)	GOOD(5)	RECOVERED(4)	✓MODERATE(2)	RELOCATION
W(2)	✓FAIR(3)	✓RECOVERING(3)	LOW(1)	✓CANOPY REMOVAL
NE(1)	POOR(1)	RECENT OR NO RECOVERY(1)		DREDGING
				✓ONE SIDE CHANNEL MODIFICATION

MODIFICATION/OTHER (cont.): IMPOUND, ISLAND, LEVEED, BANK SHAPING

MMENTS: _____

PARIAN ZONE AND BANK EROSION: (Check ONE box or Check 2 and AVERAGE per bank) RIPARIAN SCORE 5.5

: Right Looking Downstream

RIAN WIDTH (per bank) R (per bank): WIDE >150 ft.(4), MODERATE 30-150 ft.(3), ✓NARROW 15-30 ft.(2), VERY NARROW 3-15 ft.(1), NONE(0)

EROSION/RUNOFF-FLOODPLAIN QUALITY

L	R	(most predominant per bank)
		FOREST, SWAMP(3)
		OPEN PASTURE/ROW CROP(0)
✓	✓	RESID.,PARK,NEW FIELD(1)
		FENCED PASTURE(1)

L	R	(per bank)
		URBAN OR INDUSTRIAL(0)
		SHRUB OR OLD FIELD(2)
		CONSERV. TILLAGE(1)
		MINING/CONSTRUCTION(0)

BANK EROSION

L	R	(per bank)
✓		NONE OR LITTLE(3)
	✓	MODERATE(2)
		HEAVY OR SEVERE(1)

MMENTS: _____

OOL/GLIDE AND RIFFLE/RUN QUALITY NO POOL = 0 POOL SCORE 6

.DEPTH (Check 1): ft.(6), -4 ft.(4), -2.4 ft.(2), .2 ft.(1), .6 ft.(Pool=0)(0)

MORPHOLOGY (Check 1): POOL WIDTH>RIFFLE WIDTH(2), ✓POOL WIDTH=RIFFLE WIDTH(1), POOL WIDTH<RIFFLE WIDTH(0)

POOL/RUN/RIFFLE CURRENT VELOCITY (Check all that Apply): TORRENTIAL(-1), ✓FAST(1), ✓MODERATE(1), SLOW(1), EDDIES(1), INTERSTITIAL(-1), INTERMITTENT(-2)

MMENTS: _____

RIFFLE SCORE 4

LE/RUN DEPTH: ENERALLY >4 in. MAX.>20 in.(4), ENERALLY >4 in. MAX.<20 in.(3), ENERALLY 2-4 in.(1), ENERALLY <2 in.(Riffle=0)(0)

RIFFLE/RUN SUBSTRATE: STABLE (e.g., Cobble,Boulder)(2), ✓MOD.STABLE (e.g., Pea Gravel)(1), UNSTABLE (Gravel, Sand)(0), NO RIFFLE(0)

RIFFLE/RUN EMBEDDEDNESS: EXTENSIVE(-1), ✓MODERATE(0), LOW(1), NONE(2), NO RIFFLE(0)

MMENTS: _____

RADIENT (FEET/MILE): 23.5 % POOL 10% % RIFFLE 10% % RUN 80% GRADIENT SCORE 8

REAM: Turkey Creek 2 RIVER MILE _____ DATE: 10-19-01 QHEI SCORE 38.5

SUBSTRATE: (Check ONLY Two Substrate Type Boxes: Check all types present) SUBSTRATE SCORE 1

	POOL	RIFFLE		POOL	RIFFLE
BLDER/SLAB(10)			GRAVEL(7)	✓	✓
BOULDER(9)			SAND(6)	✓	✓
COBBLE(8)			BEDROCK(5)		
HARDPAN(4)			DETRITUS(3)		
✓ MUCK/SILT(2)			ARTIFIC(0)		✓

SUBSTRATE ORIGIN (all): LIMESTONE(1); ✓ TILLS(1); SANDSTONE(0); SHALE(-1); COAL FINES(-2); RIP/RAP(0); HARDPAN(0)

SILT COVER (one): ✓ SILT-HEAVY(-2); SILT-NORM(0); SILT-MOD(-1); SILT-FREE(1)

Extent of Embeddedness (check one): ✓ EXTENSIVE(-2); LOW(0); MODERATE(-1); NONE(1)

L NUMBER OF SUBSTRATE TYPES: >4(2) 4 <4(0)

E: (Ignore sludge that originates from point sources: score is based on natural substrates)

MMENTS: _____

STREAM COVER: COVER SCORE 9

TYPE (Check all that apply): NDERCUT BANKS(1); VERHANGING VEGETATION(1); HALLOWS (IN SLOW WATER)(1); DEEP POOLS(2); ROOTWADS(1); BOULDERS(1); OXBOWS(1); ✓ AQUATIC MACROPHYTES(1); LOGS OR WOODY DEBRIS(1)

AMOUNT (Check only one or Check 2 and AVERAGE): EXTENSIVE >75%(11); ✓ MODERATE 25-75%(7); SPARSE 5-25%(3); NEARLY ABSENT <5%(1)

MMENTS: _____

HANNEL MORPHOLOGY: (Check ONLY ONE per Category or Check 2 and AVERAGE) CHANNEL SCORE 5

OSITY: GH(4); DERATE(3); W(2); NE(1)

DEVELOPMENT: EXCELLENT(7); GOOD(5); FAIR(3); ✓ POOR(1)

CHANNELIZATION: NONE(6); RECOVERED(4); RECOVERING(3); ✓ RECENT OR NO RECOVERY(1)

STABILITY: HIGH(3); ✓ MODERATE(2); LOW(1)

MODIFICATION/OTHER: SNAGGING; RELOCATION; ✓ CANOPY REMOVAL; DREDGING; ONE SIDE CHANNEL MODIFICATION; IMPOUND; ISLAND; LEVEED; BANK SHAPING

MMENTS: _____

PARIAN ZONE AND BANK EROSION: (Check ONE box or Check 2 and AVERAGE per bank)

r Right Looking Downstream RIPARIAN SCORE 2.5

RIAN WIDTH (per bank)

R (per bank): WIDE >150 ft.(4); MODERATE 30-150 ft.(3); ✓ NARROW 15-30 ft.(2); VERY NARROW 3-15 ft.(1); NONE(0)

EROSION/RUNOFF-FLOODPLAIN QUALITY

L	R	(most predominant per bank)	L	R	(per bank)
		FOREST, SWAMP(3)			URBAN OR INDUSTRIAL(0)
✓	✓	OPEN PASTURE/ROW CROP(0)			SHRUB OR OLD FIELD(2)
		RESID.,PARK,NEW FIELD(1)			CONSERV. TILLAGE(1)
		FENCED PASTURE(1)			MINING/CONSTRUCTION(0)

BANK EROSION

L	R	(per bank)
		NONE OR LITTLE(3)
		MODERATE(2)
✓	✓	HEAVY OR SEVERE(1)

MMENTS: _____

OL/GLIDE AND RIFFLE/RUN QUALITY NO POOL = 0 POOL SCORE 6

.DEPTH (Check 1): ft.(6); -4 ft.(4); -2.4 ft.(2); .2 ft.(1); .6 ft.(Pool=0)(0)

MORPHOLOGY (Check 1): POOL WIDTH>RIFFLE WIDTH(2); ✓ POOL WIDTH=RIFFLE WIDTH(1); POOL WIDTH<RIFFLE WIDTH(0)

POOL/RUN/RIFFLE CURRENT VELOCITY (Check all that Apply): TORRENTIAL(-1); ✓ FAST(1); MODERATE(1); SLOW(1); EDDIES(1); INTERSTITIAL(-1); INTERMITTENT(-2)

MMENTS: _____

RIFFLE SCORE 5

LE/RUN DEPTH: ENERALLY >4 in. MAX.>20 in.(4); ENERALLY >4 in. MAX.<20 in.(3); ENERALLY 2-4 in.(1); ENERALLY <2 in.(Riffle=0)(0)

RIFFLE/RUN SUBSTRATE: ✓ STABLE (e.g., Cobble,Boulder)(2) Rip-Rap; MOD.STABLE (e.g., Pea Gravel)(1); UNSTABLE (Gravel, Sand)(0); NO RIFFLE(0)

RIFFLE/RUN EMBEDDEDNESS: EXTENSIVE(-1); ✓ MODERATE(0); LOW(1); NONE(2); NO RIFFLE(0)

MMENTS: _____

RADIENT (FEET/MILE): 8.5 % POOL 0 1. % RIFFLE 5 1. % RUN 95 1. GRADIENT SCORE 10

ATTACHMENT 6

VEGETATION SURVEY

BIOLOGICAL/HABITAT ASSESSMENT REPORT:
JUDAY CREEK
ST. JOSEPH COUNTY, INDIANA

Juday Creek Botanical Inventory

11/05/2001

	Acronym	Genus	Species	Common	Wetness	CC Value	Native?
1	ACENEG	Acer	negundo	BOX ELDER	FACW-	0	TRUE
2	ACESAI	Acer	saccharinum	SILVER MAPLE	FACW	0	TRUE
3	ALLCAN	Allium	canadense	WILD ONION	FACU	2	TRUE
4	ALOGEN	Alopecurus	geniculatus	MARSH FOXTAIL	[FAC]		FALSE
5	AMBARE	Ambrosia	artemisiifolia elatior	COMMON RAGWEED	FACU	0	TRUE
6	ARCMIN	Arctium	minus	COMMON BURDOCK	UPL		FALSE
7	ARITRI	Arisaema	triphyllum	JACK-IN-THE-PULPIT	FACW-	4	TRUE
8	AROPRU	Aronia	prunifolia	CHOKEBERRY	FACW-	6	TRUE
9	ASCINC	Asclepias	incarnata	SWAMP MILKWEED	OBL	4	TRUE
10	ASCSYR	Asclepias	syriaca	COMMON MILKWEED	UPL	0	TRUE
11	ASTERI	Aster	ericoides	HEATH ASTER	FACU-	5	TRUE
12	ASTPUF	Aster	puniceus firmus	SHINING ASTER	OBL	7	TRUE
13	ASTSAS	Aster	sagittifolius	ARROW-LEAVED ASTER	UPL	5	TRUE
14	BETNIG	Betula	nigra	RIVER BIRCH	FACW	7	TRUE
15	BIDCER	Bidens	cernua	NODDING BUR MARIGOLD	OBL	5	TRUE
16	BIDCOM	Bidens	comosa	SWAMP TICKSEED	[OBL]	5	TRUE
17	BOECYC	Boehmeria	cylindrica	FALSE NETTLE	OBL	2	TRUE
18	CARDOU	Cardamine	douglassii	PURPLE SPRING CRESS	FACW	7	TRUE
19	CXCOMO	Carex	comosa	BRISTLY SEDGE	OBL	5	TRUE
20	CXHYST	Carex	hystericina	PORCUPINE SEDGE	OBL	5	TRUE
21	CXVULP	Carex	vulpinoidea	BROWN FOX SEDGE	OBL	2	TRUE
22	CARGLA	Carya	glabra	PIGNUT HICKORY	FACU	5	TRUE
23	CELOCC	Celtis	occidentalis	HACKBERRY	FAC-	3	TRUE
24	CEPOCC	Cephalanthus	occidentalis	BUTTONBUSH	OBL	5	TRUE
25	CERCAN	Cercis	canadensis	REDBUD	FACU	10	TRUE
26	CIRARV	Cirsium	arvense	FIELD THISTLE	UPL		FALSE
27	CIRVUL	Cirsium	vulgare	BULL THISTLE	FACU-		FALSE
28	CLAVIR	Claytonia	virginica	SPRING BEAUTY	FACU	2	TRUE
29	CONMAJ	Convallaria	majalis	LILY-OF-THE-VALLEY	UPL		FALSE

30	CONARV	Convolvulus	arvensis	FIELD BINDWEED	UPL		FALSE
31	COROBL	Cornus	obliqua	BLUE-FRUITED DOGWOOD	FACW+	6	TRUE
32	CORRAC	Cornus	racemosa	GRAY DOGWOOD	FACW-	1	TRUE
33	CORSTO	Cornus	stolonifera	RED-OSIER DOGWOOD	FACW	6	TRUE
34	CUSGRO	Cuscuta	gronovii	COMMON DODDER	[OBL]	4	TRUE
35	CYPESC	Cyperus	esculentus	FIELD NUT SEDGE	[FAC+]	0	TRUE
36	ECHCRU	Echinochloa	crusgalli	BARNYARD GRASS	FACW	0	TRUE
37	ELAUMB	Elaeagnus	umbellata	AUTUMN OLIVE	UPL		FALSE
38	ELEOBT	Eleocharis	obtusa	BLUNT SPIKE RUSH	OBL	3	TRUE
39	ELEPAM	Eleocharis	palustris major	GREAT SPIKE RUSH	OBL	10	TRUE
40	ELOCAN	Elodea	canadensis	COMMON WATERWEED	OBL	5	TRUE
41	EQUFLU	Equisetum	fluviatile	PIPES	OBL	7	TRUE
42	EQUHYE	Equisetum	hyemale	TALL SCOURING RUSH	FACW-	3	TRUE
43	ERISTR	Erigeron	strigosus	DAISY FLEABANE	[UPL]	5	TRUE
44	ERYAME	Erythronium	americanum	YELLOW TROUT LILY	UPL	8	TRUE
45	EUOALA	Euonymus	alatus	BURNING BUSH	UPL		FALSE
46	EUPCOE	Eupatorium	coelestinum	MISTFLOWER	FAC+		FALSE
47	EUPMAM	Eupatorium	maculatum	SPOTTED JOE PYE WEED	OBL	4	TRUE
48	EUPPER	Eupatorium	perfoliatum	COMMON BONESET	FACW+	4	TRUE
49	FRAVIR	Fragaria	virginiana	WILD STRAWBERRY	FAC-	1	TRUE
50	FRAPES	Fraxinus	pennsylvanica subintegerrima	GREEN ASH	FAC	1	TRUE
51	GEULAT	Geum	laciniatum trichocarpum	ROUGH AVENS	FACW	2	TRUE
52	HYPPER	Hypericum	perforatum	COMMON ST. JOHN'S WORT	UPL		FALSE
53	IMPCAP	Impatiens	capensis	ORANGE JEWELWEED	FACW	3	TRUE
54	IRIPSE	Iris	pseudacorus	TALL YELLOW IRIS	OBL		FALSE
55	IRIVIS	Iris	virginica shrevei	BLUE FLAG	OBL	5	TRUE
56	JUNEFF	Juncus	effusus	COMMON RUSH	OBL	7	TRUE
57	LAMPUR	Lamium	purpureum	PURPLE DEAD NETTLE	UPL		FALSE
58	LARDEC	Larix	decidua	EUROPEAN LARCH	UPL		FALSE
59	LOBSIP	Lobelia	siphilitica	GREAT BLUE LOBELIA	FACW+	6	TRUE
60	LONJAP	Lonicera	japonica	JAPANESE HONEYSUCKLE	FACU		FALSE
61	MERVIR	Mertensia	virginica	VIRGINIA BLUEBELLS	FACW	5	TRUE

62	MIMRIN	Mimulus	ringens	MONKEY FLOWER	OBL	6	TRUE
63	MORALB	Morus	alba	WHITE MULBERRY	FAC		FALSE
64	MYOSCO	Myosotis	scorpioides	COMMON FORGET-ME-NOT	OBL		FALSE
65	OENBIE	Oenothera	biennis	COMMON EVENING PRIMROSE	FACU	0	TRUE
66	PARQUI	Parthenocissus	quinquefolia	VIRGINIA CREEPER	FAC-	2	TRUE
67	PEDLAN	Pedicularis	lanceolata	FEN BETONY	[OBL]	9	TRUE
68	PELVIR	Peltandra	virginica	ARROW ARUM	OBL	10	TRUE
69	PHAARU	Phalaris	arundinacea	REED CANARY GRASS	FACW+		FALSE
70	PHYAME	Phytolacca	americana	POKEWEED	FAC-	1	TRUE
71	PLAMAJ	Plantago	major	COMMON PLANTAIN	FAC+		FALSE
72	PLAOCC	Platanus	occidentalis	SYCAMORE	FACW	9	TRUE
73	PODPEL	Podophyllum	peltatum	MAY APPLE	FACU	4	TRUE
74	POLPEN	Polygonum	pensylvanicum	PINKWEED	FACW+	0	TRUE
75	POPDEL	Populus	deltoides	EASTERN COTTONWOOD	FAC+	2	TRUE
76	PRUSER	Prunus	serotina	WILD BLACK CHERRY	FACU	1	TRUE
77	QUEBIC	Quercus	bicolor	SWAMP WHITE OAK	FACW+	6	TRUE
78	QUEPAU	Quercus	palustris	PIN OAK	FACW	8	TRUE
79	RHUTYP	Rhus	typhina	STAGHORN SUMAC	UPL	1	TRUE
80	ROSMUL	Rosa	multiflora	MULTIFLORA ROSE	FACU		FALSE
81	RUBOCC	Rubus	occidentalis	BLACK RASPBERRY	UPL	2	TRUE
82	RUMACE	Rumex	acetosella	FIELD SORREL	[FACU]		FALSE
83	RUMCRI	Rumex	crispus	CURLY DOCK	FAC+		FALSE
84	SALBAB	Salix	babylonica	WEEPING WILLOW	FACW		FALSE
85	SALINT	Salix	interior	SANDBAR WILLOW	OBL	1	TRUE
86	SALNIG	Salix	nigra	BLACK WILLOW	OBL	4	TRUE
87	SAMCAN	Sambucus	canadensis	ELDERBERRY	FACW-	1	TRUE
88	SANCAD	Sanguinaria	canadensis	BLOODROOT	FACU-	6	TRUE
89	SANMAR	Sanicula	marilandica	BLACK SNAKEROOT	[FACU]	6	TRUE
90	SASALB	Sassafras	albidum	SASSAFRAS	FACU	3	TRUE
91	SCIACU	Scirpus	acutus	HARD-STEMMED BULRUSH	OBL	6	TRUE
92	SCIFLU	Scirpus	fluviatilis	RIVER BULRUSH	OBL	4	TRUE
93	SENAUR	Senecio	aureus	GOLDEN RAGWORT	FACW	7	TRUE

94	SOLALT	Solidago	altissima	TALL GOLDENROD	FACU	1	TRUE
95	SOLGRG	Solidago	graminifolia	COMMON GRASS-LEAVED GOLDENROD	FACW-	4	TRUE
96	TRIREC	Trillium	recurvatum	RED TRILLIUM	FACU-	5	TRUE
97	TYPLAT	Typha	latifolia	BROAD-LEAVED CATTAIL	OBL	1	TRUE
98	URTDIO	Urtica	Dioica	STINGING NETTLE	FAC+		FALSE
99	VERTHA	Verbascum	thapsus	COMMON MULLEIN	UPL		FALSE
100	VERHAS	Verbena	hastata	BLUE VERVAIN	FACW+	4	TRUE
101	VERFAS	Vernonia	fasciculata	COMMON IRONWEED	FACW	5	TRUE
102	VIBOPU	Viburnum	opulus	EUROPEAN HIGHBUSH CRANBERRY	[FACU]		FALSE
103	VINMIN	Vinca	minor	PERIWINKLE	UPL		FALSE
104	VIOSOR	Viola	sororia	COMMON BLUE VIOLET	FAC-	3	TRUE
105	VITRIP	Vitis	riparia	RIVERBANK GRAPE	FACW-	2	TRUE